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ANNALS *of* SURGERY

Vol. XC SEPTEMBER, 1929 No. 3

FRACTURE DISLOCATION OF THE CERVICAL SPINE*

By Alfred S. Taylor, M.D.
of New York, N. Y.

For many years these lesions of the cervical spine resulted chiefly from diving accidents, football injuries, falls from horses, and weights falling on heads. Nowadays automobile wrecks add many cases to the list. Most of these injured people are cared for by general surgeons.

Since methods of procedure vary greatly, and since ill-advised immediate

Fig. 1.—Patient on Hawley fracture table with everything ready for reduction. (*a*) Counter extension on lower extremities; (*b*) steadying of shoulders to keep patient from slipping off the narrow metal spinal strip; (*c*) operator exerting traction by his body weight while steadying the head and neck with both hands.

operation is urged in many instances, an attempt should be made to establish certain fundamental principles as guides to treatment.

These principles can be deduced only by orderly consideration of the pathological features, which in turn result from the etiological factors and then to determine the aims of treatment and the best methods of attaining the desired results.

It is evident that the bone lesion, *per se*, is of relatively minor importance, and that the seriousness of the injury depends entirely upon the damage, present and prospective, of the nerve tissues involved. The sole aim of treatment must be to repair or prevent damage to the nerve structures, a result greatly furthered by reduction of bony deformity. It is fundamental to clearly under-

* Read before the New York Surgical Society, April 10, 1929.

stand the pathology involved in order to work out the principles of treatment.

For the sake of clarity we must differentiate the cases due to: (1) Direct violence, and (2) indirect violence (usually hyperflexion).

Those due to direct violence scarcely enter our present discussion, because direct violence sufficient to cause dislocation of vertebral bodies would do irreparable damage to the cord, and almost surely cause immediate death.

Indirect violence, acting through the mechanism of hyperflexion, in the cases under discussion, is the cause of the pathology, which always involves:

FIG. 2.—Details of head-end of apparatus. Suspension head-strap with gauze pad in the chin part to soften the pressure. A similar arrangement made of two-ply moleskin, or heavy Z. O. adhesive is easier on the patient and can be incorporated in the plaster case with less discomfort to the patient.

(1) The spine and its accessories; (2) the cord and meninges to variable degree; (3) nerve roots to variable degree.

In each of these structural groups the resulting pathology may be classified as immediate and remote.

1. SPINE. *Immediate.*—The most important element in the spinal injury is the dislocation, as this to a large degree determines the amount of injury to the spinal cord.

Associated with this dislocation there is:

(*a*) Nearly always comminuted fracture of the tips of the articular processes involved.

(*b*) Always rupture of articular ligaments.

(*c*) Always rupture of the intervertebral disc, frequently with damage to one or both of the vertebral bodies to which it was attached. The blood supply to both the disc and the vertebral bodies is seriously impaired.

(*d*) Frequently comminuted fracture of the anterior edges of the vertebral bodies.

(*c*) In a few very severe injuries, gross fracture of one or both of the vertebral bodies concerned, as well as occasional fractures of the posterior arches.

Remote.—Persisting deformity, if not reduced at or shortly after the time of injury. Even when satisfactory reduction is accomplished, there are sure to be certain secondary changes which have an important bearing on the methods and duration of the treatment.

The intervertebral disc, which has been contused and ruptured and has

FIG. 3.—During reduction. Note the rope about the operator's waist running through the rings of the headpiece. The operator by leaning back uses his weight as a steady traction machine under perfect control. The operator's hands support the neck and occiput, with the index fingers just below the lower of the two vertebræ involved. The thumbs lie in front of the neck and can be used to push the upper of the two vertebræ upward and backward while the index fingers crowd the lower vertebræ forward, as soon as the muscles have yielded sufficiently to the steady traction. An assistant steadies the patient on the metal strip, also pulls downward on the shoulders.

had its blood supply damaged, undergoes gradual degeneration and absorption, especially in its anterior portion, so that eventually the vertebral bodies come in contact anteriorly and undergo bony union.

In cases not properly cared for the vertebral bodies may undergo considerable erosion before bony union occurs because they have been injured, their blood supply damaged, and the intervertebral disc buffer largely absorbed. The amount of erosion can be largely influenced by treatment. In any case, the absorption of the disc anteriorly causes some angulation of the spine and this angulation will be increased by erosion of the vertebral bodies, which is always most marked in front.

Eventually bony union occurs between the vertebral bodies in front, and between the articular processes behind, and whatever deformity is then present becomes fixed. Marked angulation, fixed by bony union, is a constant menace to the cord from the continuous pressure of the cord against the angle.

2. Cord. *Immediate.*—The cord may be merely contused; may be completely severed or may suffer any degree of injury between these two extremes. There may be hæmorrhage—usually punctate (or gross, rarely). Within a few hours post-traumatic œdema occurs, varying with the degree of injury. The dura rarely shows gross damage except when punctured by a bony fragment and this happens infrequently.

Fig. 4.—(Case II.) Before reduction. Dislocation of the fifth cervical forward on the sixth cervical vertebra. Note locking of articular processes and that extension at first must be forward to unlock them with the minimum force and traction.

The pia-arachnoid is damaged in the more severe cases, with resulting hæmorrhage, and subsequent adhesions to cord and dura.

The cord fibres which are ruptured by the primary injury undergo permanent degeneration; the other fibres may suffer temporary or permanent loss of function because of swelling due to hæmorrhage or œdema within the cord causing pressure against an unyielding dura; or because of continuing external pressure from extradural clot or displaced bone. Continued pressure, when sufficiently severe, results in permanent degenerative changes in the cord structures.

Remote.—Aside from the persisting results of damage to the cord by the primary injury and the secondary hæmorrhage and œdema, there is one other important source of remote pathology:

When the cord has escaped entirely, or almost entirely, and has recovered, but the bone deformity has not been corrected and prevented from recurring by proper treatment, after a period varying from a few months to a year, there is likely to develop a transverse pressure myelitis of the segment of cord which rides over the backward-projecting upper margin of the body of the lower vertebra and beneath the posterior arch of the vertebra above, with corresponding loss of cord function.

Fig. 5.—(Case II.) Reduction first time. Note that intervertebral disc is diminished in thickness and articular processes are not quite seated home.

3. Nerve Roots. *Immediate.*—The two nerve roots emerging between the two vertebræ involved are nearly always injured. As the majority of dislocations involve the

fifth and sixth cervical vertebræ, it is usually the sixth nerves which are damaged, usually more on one side than the other.

Remote.—If bone displacement is not corrected, chronic traumatic neuritis with permanent impairment of function occurs. This impairment is usually incomplete.

Symptomatology.—The damage of the bony spine will be indicated by deformity (difficult to make out without undue manipulation), localized tenderness and pain, limitation of motion in certain directions, and characteristic forward attitude of head and upper neck.

FIG. 6.—(Case II.) One year after the primary reduction, two recurrences of deformity having occurred and attempt at fixation by open operation having been made. Note the deformity, and that there is no sharp angulation of the spinal cord, that the intervertebral disc has almost disappeared anteriorly, and that bony union has occurred between the vertebral bodies anteriorly.

Stereoscopic X-ray plates give the most reliable evidence with the least traumatism. Lateral plates, stereoscopic, are the valuable ones.

Damage to the cord is indicated by more or less complete loss of its function at and below the level of the injury. The degree of damage to the cord is very variable and is not necessarily in proportion to the bony displacement as found in the pictures. With some quite marked displacements there is relatively little evidence of cord injury, and in some profound injuries of the cord the bony distortion is not so much as one would expect. Marked bony displacement may occur with no evidence of primary injury of the cord.

The first group with marked distortion and absent or only slight or moderate cord injury can be accounted for by the fact that the cord takes up but a relatively small proportion of the area of the cervical canal, and so may luckily escape.

The second group, with moderate distortion and severe damage to the cord, are not so easily accounted for, but there are two mechanisms which may be postulated. One is that the distortion at the moment of injury is sufficiently great to injure the cord, and then is spontaneously partially reduced. This is a purely hypothetical explanation which is reasonable, but which cannot be proved or disproved.

The other is that the cord is pulled forward and tensed by the hyperflexion of the spine and is bumped against the angulation of the bone at the level of injury.

This seems a more valid explanation because of the following facts:

1. The cord is anchored at its upper end by the structures at and above

FIG. 7.—(Case II.) Four years after reduction showing ossification between bodies and articular processes of the fifth and sixth vertebræ. Note the extension downward of the anterior lip of the fifth cervical. Intervertebral disc almost gone.

the foramen magnum, and by the upper cervical nerves which pass out of the canal almost at right angles to the cord. The lower end is anchored by the filum terminale.

2. During laminectomies it is noticeable that some cords are less movable than others, *i.e.*, strung more tightly between the ends.

3. As the spine is flexed the distance between the two attachments of the ends is increased, and the cord naturally goes forward in the canal to seek the shortest distance between its two ends. For this same reason the spine is well flexed to get the caudal nerves forward out of the way in doing lumbar puncture for the various purposes of diagnosis and treatment.

4. Certain cases have been reported in which serious loss of cord function has followed injury associated with marked flexion of the spine, but without any discoverable lesion of the bony spine.

It is obvious that the relatively tense cords would be the ones to suffer most.

Not infrequently a case occurs in which there is marked impairment of function in the upper extremities due entirely to damage of the nerve roots, with evidence of cord injury entirely absent or very slight. This emphasizes the necessity of keeping clearly in mind the two types of nerve tissue damage in order to arrive at the correct diagnosis. A capable neurologist should always be called in consultation.

Damage to the cord is indicated by impairment of function below the level of the injury. This impairment may range from very slight to complete loss. Except in cases of complete loss there is usually unequal involvement of the two sides as to both sensory and motor function, this depending on the distribution of the dam-

FIG. 8.—(Case III.) Before reduction. Note extreme forward displacement and tilting of the fifth cervical vertebra and locking of articular processes.

age which the trauma has caused in the various conducting paths of the cord.

Damage of the nerve roots is usually confined to the two which emerge between the two vertebræ involved. They are compressed and lacerated between the displaced bones. Pain and paralysis in the *root distribution* appear and the reflexes of the muscles supplied from these roots are diminished or absent, according to the degree of injury. If the bony compression is not relieved, a partial loss of function in these nerves may become complete. These nerve root injuries do not cause definite sensory disturbances because no one of these nerves supplies exclusive sensation to any area of skin.

FIG. 9.—(Case III.) Taken on the table immediately after reduction, showing complete reduction.

One most important fact must be stressed; *i.e.*, when there is, primarily, complete loss of cord function below the level of the lesion, it is impossible to determine at once whether there is merely a complete physiological transverse block, or a true anatomical transverse lesion. In many cases there is a partial anatomical lesion, with complete physiological block of the remainder of the cord.

FIG. 10.—(Case III.) Three days after reduction. In plaster case.

TREATMENT.—As before stated the chief aim of treatment is the restoration and protection of nerve function. The first principle of treatment in a fresh case is to avoid causing additional damage. The history of the accident, the pain in the neck, and the visible evidences of disturbed function of the cord and nerves should suggest the diagnosis. Turning the patient, manipulating the neck, head, etc., to get corroborative evidence is not only painful but adds to the patient's risk. Evidences of sensory and pyramidal tract disturbances may be obtained without danger. Good X-ray plates give perfectly satisfactory evidence as to the bone distortion and can be taken with practically no manipulation of the patient, with modern portable apparatus. Immediately after the accident

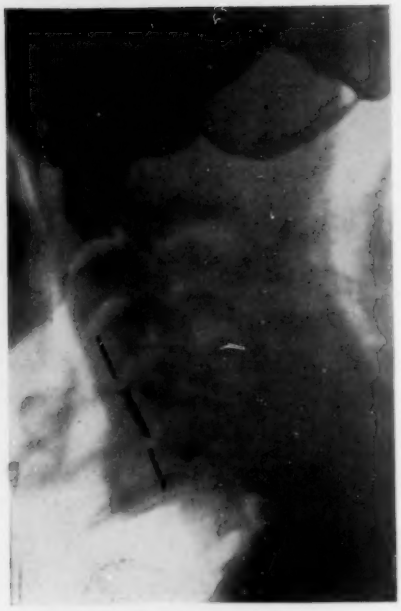


FIG. 11.—(Case III.) Six weeks after reduction. Still in case and alignment perfect.

the patient should be placed on a flat stretcher, being careful to move the shoulders, neck and head in one piece as nearly as possible. Pillows or cushions under the head are undesirable because of their tendency to increase the dislocation. For the same reason, a sagging or hammock stretcher is bad because of its tendency to flex the spine and exaggerate the deformity.

He is transferred to a flat bed. The portable X-ray machine is used, lateral plates being much more significant than the anteroposterior ones which usually give no adequate idea of the distortion.

With the diagnosis verified, the second principle of treatment is to restore the various anatomical structures to their normal relations as nearly as possible. This restoration minimizes the immediate, and prevents the remote injury to the nerve tissues, by removing the continuous pressure of the displaced bones from the cord and nerves.

The third principle consists in fixation of the spine from the lumbar region up to the skull, so applied as to cause some elongation and backward extension of the cervical spine above the level of injury. This fixation must continue until bony union occurs as previously described, and this usually requires twelve months.

The application of these principles, by a method to be described, will result in practically perfect restoration of anatomical relations and the best possible conditions for such spontaneous recovery as is possible in the damaged nerve tissues. The sooner after injury the restoration is attempted, the more easily and perfectly will it be accomplished. The only element of danger still to be faced is that of the œdema of the cord which follows these injuries, and may develop to such a degree as to menace that portion of the cord not irreparably damaged primarily. This factor will be discussed later. For the present, suffice it to say that the anatomical

FIG. 12.—(Case III.) Sixteen months after reduction, with the use of constant extension apparatus. Note the absorption of the anterior portion of intervertebral disc with tilting forward of upper spine and consequent slight angulation. Note also the well-advanced ossification between the two vertebræ.

restoration allows the maximum amount of space within the dura and so minimizes the menace of the œdema.

METHOD. *Anæsthesia.*—As a rule the procedure is not painful and no general anæsthetic need be used. Where the cord has been so damaged that the diaphragm alone carries on respiration, general anæsthesia adds to the risk, as does morphine, by depressing the respiratory centre. Nevertheless in the third case, because of painful clonic spasms in the cervical muscles and a high degree of nervousness, general anæsthesia was used without undesirable consequences.

Before any manipulation starts, everything must be organized for smooth progression. A proper fracture table (*e.g.*, Hawley's) must be available; a good orthopædic associate with knitted shirting, padding, bandages and plaster for the jacket must be present; and a good, portable X-ray machine and technician must be ready to take and develop plates to verify the reduction when it is thought to have been accomplished.

Unless these details are carefully arranged beforehand the chances of complete success are diminished.

The method herewith presented was first tried in August, 1911. It is simple and has proved efficient.

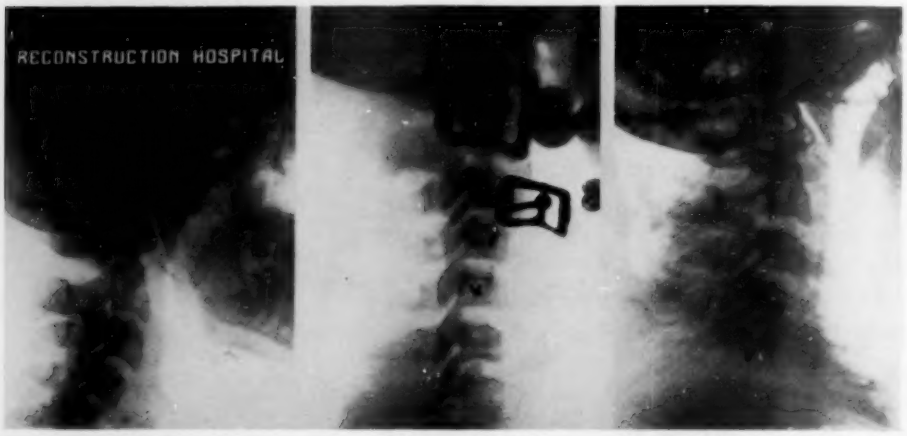
FIG. 13.—(Case III.) Anteroposterior view at sixteen months, showing apparent fusion of the articular processes.

The principle consists in controlled traction exerted on the head (with counter traction on the lower extremities) until the spasmodically contracted cervical muscles have relaxed sufficiently to permit reduction by bimanual manipulation on the part of the operator. Fixation is maintained by a plaster jacket involving the trunk and neck, the neck portion maintaining extension of the neck by pressure upward against the occiput and inferior maxilla, and downward against the shoulders. The most convenient arrangement is that shown in the accompanying illustrations. (Figs. 1, 2 and 3.) The patient is placed supine on a Hawley fracture table, with the trunk from the waist line upward supported on a narrow metal strip padded slightly and ending between the scapulæ.

An orthopædic suspension headpiece is applied. Through its two suspension rings which lie just above the vertex of the patient's skull a double bight of clothesline is passed and is tied around the pelvic girdle of the operator, so as to keep the patient's vertex only a short distance from the operator, who faces the patient and grasps his neck in the damaged area, supporting the head also with his hands. Meanwhile, the lower extremities of the patient are bound to the table, or held by strong assistants, to give counter traction.

Another assistant may be necessary to keep the patient's body balanced on the narrow metal strip between his scapulæ.

When everything is ready, the operator applies traction on the neck muscles, gradually and increasingly, by backing his body away while holding the neck between his two hands, thus maintaining absolute control of the whole procedure. The traction is at first exerted in the axis of that portion of cervical spine *above* the injury so as to unlock the articular processes of the damaged vertebræ. After traction for a period varying with the strength and degree of spasm of the neck muscles (from five to ten minutes) the neck will be felt to elongate gradually, the bones to unlock, and then the



Before. After reduction. November 22. In case.

FIG. 14.—(Case V.) Left-side picture shows dislocation of fourth cervical on fifth cervical vertebra. Note the wedge-shaped compression of fifth cervical, the comminuted fragments projecting forward, and the displacement of the body backward into the canal. Mid-picture.—The alignment after reduction by vertical suspension (in association with Dr. J. J. Moorehead). Right-side picture.—In plaster case two days after reduction.

head and upper spine are allowed to sag gently downward while still under traction until reduction is accomplished, the operator's hands assisting by propping the lower segment of the cervical spine posteriorly and manipulating the upper segment gently with the thumbs anteriorly, if necessary, to complete the reduction.

Reduction is indicated: (*a*) Sometimes by the patient who feels the bones slide into place, with immediate relief of previous discomforts; (*b*) by finding the spinous processes in proper alignment and spacing; (*c*) by a plate taken by a portable machine and developed while the patient is retained on the table. This last is always done as a check.

As soon as the reduction is verified, a good orthopœdist should apply a well-padded plaster-of-Paris jacket (previously described) while the operator maintains the head and neck in correct position. This jacket should insure moderate extension of the neck between the shoulders and occiput and chin, with slight backward flexion of the head and upper part of the neck to check any tendency to recurrence, or to undue erosion of the anterior portions of the damaged vertebral bodies.

It is very important to have the jacket include the trunk down to the iliac crests in order to have firm fixation for the cervical portion.

In Case II the plaster jacket was replaced by a reinforced leather collar and breast plate, and in Case IV a plaster collar with a broad extension down over the chest and back was used, but these failed to prevent recurrence.

After-treatment consists in keeping the jacket on for several weeks (three to four), taking an occasional film to make sure that reduction is maintained. At the end of this period the jacket may be split down each side and carefully removed to permit measurement for a spinal brace with jury-mast and cupped arrangement to fit and hold up the chin, jaw and occiput. The cast is then replaced, fastened with adhesive plaster, and left on until the brace is ready. When this is applied the patient may get up when able.

FIG. 15.—(Case VII.) Two months after accident. Fifth cervical on sixth cervical vertebra. Note the angulation, also the chipping of the anterior upper margin of sixth cervical, and the apparent projection backward into the canal of calcified material from the contiguous margins of the two vertebræ.

From the time of reduction such physical therapy as is indicated and feasible should be systematically used during the entire period of convalescence.

FIG. 16.—(Case VII.) Taken on the table just after reduction which was obviously complete. Note the thinning of the disc and the roughened outlines of the approximated vertebral surfaces.

In Case V, because no suitable table was available, Doctor Moorehead suggested that we use the regular orthopœdic suspension apparatus. The patient on a stretcher was placed under the suspension frame, the headpiece was applied, and he was carefully lifted to the sitting posture as the head was pulled up by the fall and tackle which was vertically above him. Traction was gradually increased, the body being held in the vertical sitting position and acting as the counterweight. After a few minutes the muscles relaxed and by gentle manipulation reduction was accomplished. (Fig. 14.) The jacket was applied as soon as the film verified the reduction, the suspension strap about the chin and occiput being left *in situ* (and extracted three days later).

The procedure worked out perfectly in

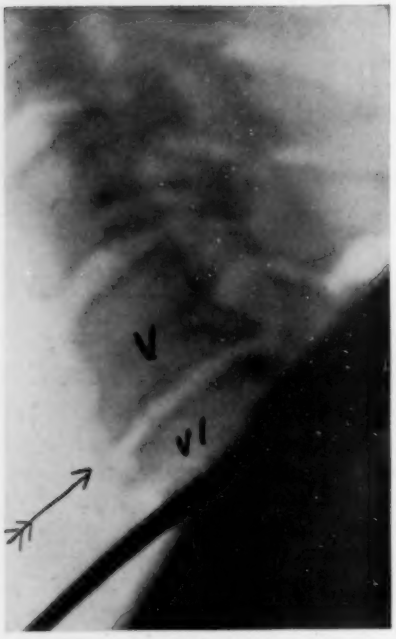


FIG. 17.—(Case VII.) Three weeks after reduction while in a steel brace. Ossification is apparently present between the anterior margins of the two vertebræ. Apparently his osteoarthritic tendency greatly hastened his function.

this case and the position greatly facilitated the application of the plaster jacket. He was a young lad, not so very heavy, and although completely paralyzed below the sixth cervical segment, could be handled with reasonable ease.

With a full grown adult the procedure would involve rather greater risk of accident in the handling and does not permit quite the same facility in manipulation of the head and upper spine during reduction.

In cases where the elapsed time has been such (see Case IV) that reduction by these procedures cannot be accomplished because of the fixation of the tissues about the area of injured spine, suspension traction over a period of weeks should be tried, just as in the case of overriding fractures in long bones. The same suspension headpiece is applied and tied to the head of the bed which is then elevated so as to use the sliding body for traction. If this does not succeed, and the cord has shown but little evidence of damage, then fixation by brace should be used until ossification has occurred. If, during this time, evidences of increasing cord involvement appear, usually indicated by advancing spastic paresis, decompression by laminectomy is indicated. (An interesting and ingenious ambulatory extension apparatus devised by Dr. J. E. J. King is referred to in Case VI.)

Open operation in the acute stage of these injuries must be mentioned, chiefly to draw attention to its very great dangers.

1. The handling necessary to posturing the patient on the table for operation, and returning him to his bed, involves great risk of added damage to the cord, especially as the attendants are not likely to have had much experience in handling such cases.

2. The removal of the arches takes

FIG. 18.—(Case VIII.) Second cervical on third cervical vertebra on the right side. At first sight there seems little evidence of deformity. The second body projects more forward over the third than the others and careful inspection of the spinous processes of second cervical and third cervical vertebræ in this plate and the next will show that second cervical is abnormally forward.

away a large part of the remaining stabilizing apparatus at the site of the injury.

3. Open operation cannot so readily reduce the deformity, as can the method described, and the only thing that it can accomplish is decompression of the damaged cord by a generous laminectomy with splitting of the dura from a point well above to a point well below the œdematous damaged portion of the cord.

Many years ago three cases were operated upon in this manner by the author, the interval between injury and operation varying from one to four days. They were in good general condition except for the loss of cord function below the sixth cervical segment.

In each case when the dura was split, the cord fractured and extruded damaged fragments.

Shortly after operation the temperature rose steadily to 107° F. and death occurred within twenty-four hours. The change was startling and discouraging.

4. Operation involving the cervical cord carries much greater risk than operation on lower portions of the cord.

The only reliable indication for operation in spinal cord injuries, as brought out by Coleman, of Richmond, is evidence of subarachnoid block as indicated by the manometric test, and even in the presence of such complete block in the *cervical region*, the above disastrous experience would make me hesitate.

Fig. 19.—(Case VIII.) After reduction. Note the difference in relation of bodies and spinous processes compared to Fig. 18.

If after the vertebral bodies have become reasonably consolidated, there develop signs of transverse myelitis (and this is very likely to occur in cases which are merely put up in fixation apparatus without the reduction of the dislocation), a laminectomy, involving at least one above and one below those vertebræ originally damaged, should be done and the dura be split and left open the entire length of the exposure. This allows backward displacement of the cord and release from pressure on its columns.

ILLUSTRATIVE CASES

Case I.—W. B. L., male, seventeen years of age. Forward dislocation of fifth cervical on sixth cervical resulted from a diving accident on August 12, 1911, with complete loss of cord function below the sixth cervical segment. During the first week there was a slight return of sensation, slight movement in the great toes, but no recovery in the sphincters. Films showed fifth cervical displaced forward on sixth cervical about one centimetre. Reduction was done August 19, 1911, without anæsthesia. Recovery was increasingly rapid; sphincteric control was complete within two months, and within a year he was driving his car, dancing, etc. The only residual was a slight spasticity of the lower extremities and a slight hypæsthesia of the tip of the right index finger (injury

of nerve root). When seen at the end of nine years there was much less but still slight spasticity. The hypæsthesia of the index finger had disappeared.

Case II.—J. F., male, twenty-seven years of age. Previous history: recurrent dislocations of the left shoulder and both patellæ following injuries. Forward dislocation of fifth cervical on sixth cervical while wrestling on February 23, 1920. (Fig. 4.) Marked pain on movement of head and neck. Marked, though incomplete, motor and sensory loss in both upper extremities with pain in the neck and shoulders (brachial plexus roots injury). Very slight sensory-motor disturbance in the trunk and lower extremities, with increased knee-jerks and ankle-jerks. Babinski absent, and Oppenheim present on both sides (*i.e.*, very slight cord injury). No loss of sphincters. Reduction without anæsthesia March 3, 1920. He felt the bones slip into place in about five minutes, said his pains had stopped, and the arms moved more freely. (Fig. 5.)

The plaster jacket was applied. After a week it became irksome, was removed and a lighter one substituted. On March 17 a leather collar was substituted and he returned home.

Fig. 20.—(Case VIII.) Four months after reduction. Movements of head and neck perfectly normal. No pain or tenderness.

March 23, 1920 (twenty days), films showed a recurrence. He had removed the collar against instructions.

March 26 a second reduction was accomplished and jacket applied. A spinal brace with jury-mast and head support was substituted for the jacket.

June 16, 1920.—Complete recovery of motion, power and sensation except slight limitation of backward movement of right arm.

June 19, 1920.—Films showed partial recurrence.

June 24, 1920.—Under local anæsthesia the laminæ of fifth cervical and sixth cervical vertebræ were exposed. Manipulation caused very slight reduction and this could be retained only by heavy silk sutures encircling the spinous processes and laminæ of the two vertebræ. (Recurrent dislocation seemed to be his habit.)

March 17, 1921 (one year after injury), there was bony union between the two vertebræ and the brace was discarded. (Figs. 6 and 7.)

The recovery of sensation and motion was complete. There was slight increase in the knee-jerks but no sign of spasticity in the gait.

Case III.—L. Z., female, thirty-five years of age. October 25, 1922. Thrown from an automobile and landing on the back of the head she suffered complete loss of cord function from sixth cervical downward. There were great pain and spasms in the neck muscles up to the time of reduction.

October 26, 1922 (twelve hours after injury), all motion lost below sixth cervical segment; sphincters paralyzed; reflexes absent except slow plantar flexion of right great toe. Sensation absent except for vague pain on deep pressure of the calf muscles and forcible extension of great toes. The film showed extreme dislocation of fifth cervical on sixth cervical. (Fig. 8.) Respiration was entirely diaphragmatic.

October 27, 1922.—Ether anæsthesia because of pain and muscle spasm in the neck, and the patient's insistence. Reduction was readily accomplished (Fig. 9) and the jacket applied. The pains and spasms ceased at once. On the sixth day the toes of the right foot, and the left great toe moved. Within three weeks respiration was again becoming thoracic. On the fiftieth day she recovered bladder control. In three months she stood

without assistance, but not very steadily, and returned home with a leather collar and jacket support. Improvement was slow but steady.

March 26, 1924 (seventeen months after injury) there was good bony union of the vertebræ and the brace was discarded. (Figs. 12 and 13.) She could walk quite steadily alone. The left lower extremity was rather spastic with normal sensation, while the right lower extremity had perfect motion and power with almost complete loss of sensation. (Primary intramedullary damage.) The right upper extremity showed perfect recovery and the left had made marked recovery, but still showed spastic contraction in the fingers. She had returned to her position as an office executive six months after her accident.

Case IV.—H. P., female, thirty-six years of age. October 1, 1925, she slipped on stairs and struck on the occiput. There was no evidence of damage to the cord or nerves, but from the time of accident there was limitation of movement of head and neck because of pain; embarrassed respiration from a sense of pressure and pain in the neck; dysphagia; and pains in both shoulders and the substernal region. There was no disturbance of the lower extremities. The upper extremities had free range and power of motion but abduction at the shoulders caused pain in the neck.

Fig. 21.—(Case IX.) Courtesy of Doctor Stookey. Before reduction. Note the body of sixth cervical directly in front of seventh cervical vertebra. Note the spinous process and part of the laminæ of sixth cervical remaining in normal position. The cord must have been severed. Relief of the localized pain was sufficient indication for reduction.

The spinous process of fifth cervical was prominent while that of fourth cervical was abnormally displaced both as to distance above that of fifth cervical and as to depth in the neck. Also fourth cervical was extremely sensitive to pressure. The films showed marked displacement forward of fourth cervical on fifth cervical with the usual forward tilting of the upper cervical spine. The head was rigidly held forward by the spasmodic neck muscles.

She was a tall, well-built woman, quite well except for the result of her injury. It was a month after the accident before she sought advice and had films taken. Because of the pains and spasm of the neck muscles and distortion of the spine, reduction was attempted. No anæsthetic was necessary. She was supine on the table. After ten minutes of traction, the muscles relaxed and stretched. As the manipulation seemed to cause the bones to slip into normal relations she remarked that her respiratory pains and dysphagia had disappeared and the arm pains were much less. (No portable X-ray apparatus had been available.)

A plaster collar with a large breast plate was applied. A film taken after the collar was applied showed but little change in the deformity, yet something must have happened to have caused the above relief. Ten days after the reduction (?) pain recurred in the left arm, but there was no difficulty in breathing or swallowing. Two further attempts were made at reduction but were unsuccessful and she was finally sent to an orthopœdic service. After prolonged treatment the vertebræ fused in bad position, but without the development of symptoms of cord or nerve damage.

Case V.—S. H., male, seventeen years of age. (Courtesy of Dr. J. J. Moorehead.) November 20, 1925, he suffered fracture dislocation of fifth cervical on the football field with loss of consciousness and complete loss of cord function below fifth cervical. The film showed crushing of the body of fifth cervical with displacement backward about .5 centimetre and forward dislocation of fourth cervical on fifth cervical. (Fig. 14.) Reduction was accomplished within six hours of the accident.

Because a proper fracture table was not available the boy was held in sitting posture on a stretcher, the headpiece was attached to an overhead pulley and his body was allowed to be the counterweight. No anæsthetic was used. After a short period of traction, reduction was accomplished (Fig. 14) and the plaster jacket applied. There was no recovery of cord function.

On the third day an automatic bladder was established. On the fifth day pneumonia developed and he died on the sixth day.

CASE VI.—R. S., female, fifty years of age. (Courtesy of Dr. J. E. J. King.) On January 22, 1927, she fell downstairs landing on her back and head. There was pain and stiffness in the head, neck and back for two or three days. There was also paresis of and some hypæsthesia over the left deltoid. After three days all symptoms disappeared except the deltoid disability and hypæsthesia, and slight pain in the neck. She was not conscious of any serious disturbance of the neck, sought no advice, and did her housework as usual.

FIG. 22.—(Case IX.) Taken on the table just after reduction. Pain was promptly relieved. Note the almost perfect reduction of sixth cervical vertebra and the close approximation to the fractured spinous process.

After six weeks she sought advice because of persistent pain. Films showed marked forward dislocation of fourth cervical on fifth cervical with posterior edge of fourth cervical near the anterior edge of fifth cervical which was comminuted. (Fig. 23.) There was also some crushing of the left side of the body of fifth cervical. There was a depression where the fourth cervical spinous process should have been. The neck was short and thick. The left deltoid muscle was paretic and atrophied, and there was a small area of hypæsthesia over it (nerve root damage). There was a suggestion of weakness in the external rotators of the left humerus and the supinators of the forearm. The only evidence of injury of the cord consisted of exaggeration of patellar, suprapatellar and Achilles' jerks and an exhaustible ankle-clonus on the right side.

Because the positions of the damaged vertebræ favored the development of transverse myelitis from pressure (already beginning) or completion of the dislocation with trans-section of the cord by some minor accident, reduction was advised, in spite of the six weeks which had elapsed. Doctor King made the suspension headpiece of moleskin plaster, which is softer and smoother than the leather headpiece, and rigged a fall and tackle which was fastened to the headpiece, while the patient was seated on a low stool directly beneath it. Increasing traction, the patient's seated body acting as counterweight, gradually stretched the muscles. After five minutes, finger manipulation was used to favor reduction and a film was taken. This showed progress but not satisfactory reduction. After five minutes more of traction and manipulation, a film showed fairly satisfactory reduction. (Fig. 24.) The plaster jacket was applied. During the process no anæsthetic was used. She lost consciousness for a few seconds four times.

That night, because the patient complained of pain in the neck, the gentle-hearted house surgeon cut away the entire chin support of the plaster jacket. This, of course, allowed partial recurrence of the dislocation. (Fig. 25.)

She refused another immediate reduction with the fall and tackle so Doctor King devised a very ingenious brace to cause constant traction upward on the head and neck. The body of the brace was fastened to the shoulders and chest as a foundation. Uprights on each side of the head were united by a cross-piece well above the head. The uprights

were attached to the shoulder-pieces by joints such that the uprights could be fixed at any angle so as to determine the direction of traction. The headpiece of moleskin plaster was applied and fastened to the cross-piece above the head by rubber bands (or spiral steel springs).

By these means the traction was controlled both as to direction and force. In this case the apparatus did not cause reduction (Fig. 26), and the vertebral bodies showed bony union in the distorted position nineteen months later. Laminectomy will be indicated if signs of pressure myelitis develop as a result of the deformity.

This apparatus may be admirable for ambulatory cases where immediate reduction is not possible. Whether it will answer as comfortably, in paralyzed cases confined to bed, as the old method of suspension which uses the body as counterweight, remains to be seen. Certainly, where the cord has been seriously damaged, the earliest possible reduction is desirable so that the first described method should be tried first.

FIG. 23.—(Case VI.) Before attempted reduction, six weeks after accident.

CASE VII.—J. H. B., male, fifty-nine years of age. He was always a rugged athletic man, playing tennis, golf (including the nineteenth hole), walking ten to fifteen miles at a stretch, etc. February 4, 1928, while walking in the evening he stepped off a four-foot embankment, bumping first the lumbar, then the thoracic region and finally the occiput. While not unconscious at any time, he was unable to call loudly enough to be heard for quite an interval. When found he could move neither arm nor the left lower extremity. There was a slight scalp wound and he had severe pain in his back and neck. At a local hospital, examination including X-ray films, was reported to show no evidence of serious injury to the head or spine. (Evidently the plates of the cervical spine were anteroposterior only, which usually give little or no evidence in any of these injuries.)

FIG. 24.—(Case VI.) Showing fairly good reduction.

After a week the paralyses began to improve and he was urged to walk and especially to swim (being far South) as that was considered a curative exercise for paretic limbs. Swimming was not a success and the attempt caused much pain. The right upper extremity improved considerably but the digits had but little power. The left upper extremity improved but little. The left lower extremity recovered fairly rapidly so that he walked with increasing facility.

About April 1 (two months after the accident) he returned to this country and his physician who suspected injury of the cervical spine had further films taken. These showed fifth cervical dislocated forward on sixth cervical one centimetre and tilted so that the upper cervical spine tilted forward about 40°. (Fig. 15.) The anterior upper edge of sixth cervical had been chipped off, and another shadow suggested a chip from the lower posterior margin of fifth cervical in the canal. The rest of

the spine showed marked osteo-arthritic changes especially in the lumbar vertebræ and sacro-iliac joints. The head was carried somewhat rigidly forward and movement caused pain and grating sounds. There was marked tenderness over the lower posterior cervical spine and the anterior neck muscles were rigidly held to prevent movement. There was marked pyorrhœa.

He was a short, heavy, muscular man with a large abdomen, in good general condition. Movements of the shoulders and elbows were normal and had good power. The right wrist, thumb and first two fingers had fair movement and power. The ring and little fingers had only slight power of flexion. The reflexes were normal. The left wrist and hand were practically powerless.

The reflexes of the upper muscles of the left extremity were more active than the right. The left lower extremity was spastic, but movement was good. Babinski sign was present on the left. The deep reflexes of both lower extremities were exaggerated L > R. There was disturbance of thermal sensation in the right lower extremity. It was evident that there had been damage both to the cord and some roots of the plexuses.

FIG. 25.—(Case VI.) Recurrence three days after reduction.

Inasmuch as the bony distortion was sure to cause continuous undesirable pressure on both the cord and nerves, it was decided to attempt reduction, in spite of the long interval after the injury, and the generally unfavorable conditions.

April 4, 1928 (almost nine weeks after injury), he was given a preliminary dose of morphine, and reduction was attempted. At first the neck muscles resisted vigorously but finally relaxed and after ten minutes had elongated sufficiently to favor reduction. The neck was so thick that palpation gave no information. Therefore the head and upper neck were worked backward so that reposition ought to occur and films were taken. The third plate caught the fifth and sixth vertebræ and showed practically perfect reduction. (Fig. 16.) A plaster case was then applied.

He complained of the case bitterly, developed a "wet-brain" and then pneumonia so that the case had to be removed. When these complications had finished a brace was applied, but again caused bitter complaint. Meanwhile films showed the neck still to be in perfect condition, the right hand had made rapid improvement and the left hand had improved definitely. (Fig. 17.) After about five weeks he discarded the brace against advice, and took the masseur with him into the country for the summer.

In the late fall of 1928 he reported that he was again playing tennis, and taking his walks. His left hand was not entirely recovered. When fatigued there were occasional twitchings in the leg muscles. As he has not returned to the city for personal examination no detailed status can be given.

CASE VIII.—J. A., female, four years of age. July 16, 1928, she fell down stairs, cried from fright and then played as usual. Two days later the mother noticed that she held her head a little crooked, facing left, and that washing her face, brushing her teeth, etc., caused pain in the back of the neck.

July 19.—X-ray films showed slight forward displacement of second cervical on third cervical. (Fig. 18.) From the attitude of the head, and the slight displacement showing

on the films, it seemed probable that the dislocation was unilateral and on the right side. There was no evidence of damage to the cord.

July 20, 1928, reduction was accomplished without an anæsthetic, and a plaster jacket applied. (Fig. 19.) A month later the jacket was removed and a high, padded plaster collar was substituted. This permitted moderate lateral rotation of the head, but only the slightest flexion.

December 19, 1928 (five months after reduction), she seemed perfectly normal; there had been no pain or discomfort since the reduction; films showed perfect alignment; therefore the collar was discarded. (Fig. 20.)

Case IX.—Male, twenty-five years of age. This case, in which I assisted with the reduction on his service at Beekman Street Hospital, is included with the kind permission of Dr. Byron Stookey.

The man, a steel worker, had slipped into the rubbish chute and fallen several stories landing on his buttocks. There was total loss of cord function below the seventh cervical segment. Breathing was entirely diaphragmatic. He was having severe pain in the neck. Films showed complete displacement forward of sixth cervical and displacement downward so that the body of sixth cervical seemed to be directly in front of that of seventh cervical, not tilted, but directly parallel with it. The spinous process and laminæ stayed in place and just the body of the vertebra was dislocated forward and downward. (Fig. 21.)

Fig. 26.—(Case VI.) Showing bony union between fourth cervical and fifth cervical vertebræ in distorted relation twenty-one months after the accident. (Nineteen after attempted reduction.)

It was obvious that the cord must be hopelessly crushed or severed. Reduction was attempted to relieve the sharp pains which distressed him. After five minutes of traction by Doctor Stookey the neck muscles stretched and manipulation caused complete reduction which was shown by the film taken and immediately developed. (Fig. 22.) The pain ceased. The patient lived for months, but showed no signs of recovery in the cord.

Results.—In all nine cases reduction was accomplished primarily. (In Cases IV and VI incomplete.) The interval between accident and reduction varied from two hours to nine weeks. An anæsthetic was used only in one case (III). In no case was any harm done by the procedure. It would seem not only simple, but safe. In Cases II, IV, and VI the dislocation recurred. In Case II because of the early substitution of a collar for the case. In Case IV because the plaster collar was used and evidently did not give proper support, and reduction was incomplete. In Case VI because of the removal of chin fixation a few hours after reduction. The deformity has become fixed.

Cases I, II, and VII—all with primary signs of injury to both the cord and nerves have made (I and II) complete recovery, and VII an almost complete recovery and still making progress.

Case VIII, with no signs of damage to cord or nerves, is freed from pain and limitation of head motion, and is perfectly normal.

Cases V and IX obviously had transsection of the cord. Case V died in five days. Case IX lived for months with no signs of cord recovery.

Case III with very serious primary damage to both cord and nerves has recovered sufficiently to get about comfortably and has been back at her work since six months after her accident.

Case IV had no signs of damage to cord or nerves. The primary reduction (?) relieved her local pain on respiration, and her dysphagia which did not return with recurrence of the deformity. She is now perfectly well except for fusion of her two vertebræ in distorted relations.

SUMMARY

Fracture dislocation of the neck is increasing in frequency because of motor accidents.

Etiology.—Hyperflexion of spine due to indirect violence; falls on head or buttocks; weights falling on head, diving accidents, etc.

Pathology.—Bone and associated structures. Dislocation of bone with more or less comminution; tearing of ligaments and muscles; damage to intervertebral disc. Pressure absorption of disc and erosion of damaged vertebræ where in contact. Final ossification between the damaged vertebræ.

Cord.—No damage at all; contusion of varying degree; or complete division of cord. Leptomeninges usually damaged. Dura usually escapes. Œdema occurs in a few hours if cord is damaged, and if sufficient to fill the unyielding dural canal tightly will cause degeneration of the cord. If bony distortion continues pressure of the cord against prominent bone will cause transverse myelitis.

Nerve Roots.—Usually contused between the two involved vertebræ, and if pressure is not relieved degeneration may occur.

The amount of dislocation does not determine the degree of primary injury to the cord. There may be marked dislocation with no signs of cord or nerve injury; or slight dislocation with serious cord injury.

Differentiation must be made between signs of nerve root injury, and cord injury. Usually both are present at the same time.

Diagnosis depends on the history of the accident; the local signs in the neck, including evidence of lateral films; and signs of lost cord and nerve function.

Treatment.—Primary operation is contraindicated. Cases developing signs of beginning pressure myelitis after fusion of the vertebræ in bad position require spinal decompression.

Reduction by the method presented is simple, safe and efficient.

Systematic physiotherapy is indicated.

Fixation is best continued until ossification between the two vertebræ has occurred. This minimizes the absorption of disc, the erosion of vertebræ and consequently the ultimate angulation of the spine.

Results.—In form and function, considering the type of cases, seem good.

OBSERVATIONS ON IMPAIRED SHOULDER FUNCTION AND METHODS OF TREATMENT*

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I have chosen the shoulder for a subject because it has been a joint of especial interest to me. This interest started with a feeling of compelling ignorance; and after attempting to study the joint's many vagaries, I feel that I have, perhaps, gained a small insight into some of its many problems. Larger acquaintance, however, has revealed not only how profound was that original ignorance, but how little I have learned to combat and cure its impaired function.

I disclaim presenting anything which I consider new, but rather an attempt at coördinating some clinical observations which I have made. Some of these observations, I feel, have been most helpful to me in understanding impaired shoulder function, in preventing it, and in some cases aiding in recovery.

I purpose to deal with the scapulohumeral joint principally, and the scapulothoracic joint, if I may be permitted to use such a term for purposes of discussion, only insofar as is necessary to formulate a basis for discussion. I do not purpose to deal with the joint according to the time-honored formula now current for description of disease. I am going to deal with generalities to a large extent, and certain specific factors which have to do with anatomy, physiology, physiological pathology, pathology, and treatment. Accurate details of the pathology of many of these conditions are unavailable.

The shoulder-joint is affected with all the pathological conditions that any joint is subject to, and also some that others are not apt to have, due to relationship of other structures involved in its function.

The pathological changes in a shoulder-joint are in almost every respect the same as occur in any other joint; and the treatment of these lesions is essentially the same as joint lesions elsewhere, with minor exceptions, based upon the anatomical arrangement peculiar to it.

Complete destruction of the shoulder-joint with ankylosis, if this is in a good position and complete, is not as disabling as one might at first believe. If this is elected and determined by a surgeon for adequate cause, the result is not disappointing. The conditions which lead to this are familiar to all, and the pathology, gross and microscopic, are well known. On the other hand, there are a large number of conditions, the pathology of which is not known, because they are not of such gravity as permit their study by operative procedures. Many of these conditions do not have sufficient gross changes to be apparent by our present powers of observation, nor to allure the pathologist.

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nor do they appear of such importance as to arouse any special enthusiasm in investigators who might help clarify the cause. You all have seen pain, suffering, disability, and economic loss from impairment of shoulder function, of such degrees as would warrant more attention to the problem than is usually afforded the individual patient.

The shoulder or scapulohumeral joint is the proximal end and centre of rotation of one of the longest levers in the body. The joint, by reason of its ball and socket character, has many extensive movements. The long humeral member is attached to the scapula which is a relatively short and freely moving bone with extensive surfaces for muscular attachments. The capsular ligament which unites the two bones is a tubular investment of the joint with strengthening reënforcements. It is of such length that, unsupported by muscular action, the joint surfaces can be separated a distance of almost an inch.[1] This redundancy is necessary to permit the extent of movement that can take place in the arm. The function of the ligaments is to stop extremes of movement while still keeping the articular surfaces together; but does not in any way determine the specific direction within the normal movements of the joint. The insertion of the capsular ligament and muscles determines a centre of rotation of the arm at a point in the head of the humerus, which roughly makes for an extremely short-balanced lever of the first and third class, upon which the activating muscles must exert their pull. The great difference in length of the proximal lever and the distal lever bring about factors which are most important.

The work done by the muscles moving the shoulder-joint is very great in even lifting the arm. By reason of the large amount of work they have to perform due to this arrangement, any added weight in the hand which has to be lifted increases their work, and places upon their bodies and insertions really tremendous strains, or *vice versa,* as when the body is lifted in the "chinning" feat of the athlete. The degrees of these strains should be considered in relation to the amount of pressure they cause upon painful periarticular lesions. Codman [2] has placed the fulcrum of this long and short lever as a gliding one in the glenoid fossa.

With the body standing erect, the upper limb hangs at the side, but if the body is bent forward with relaxed shoulder muscles, the limb hangs as a pendulum, it can and will swing as would a weight suspended by a string, if the body is swayed. This entails no muscular action of the shoulder muscles except suspension support. With the body in the horizontal position, the limb at the side, as when a patient is lying in bed, the pendulum character of the lever is lost. In this case any voluntary movement of the limb necessitates the lifting, support, and movement of a long and heavy lever by a very short one. One must visualize the fixation group and the activating group of muscles, each of which is put under a great strain by movements of the upper limb in this position. If the upper limb is abducted with the body in the upright position, one can readily see that the working strain of the muscles starts at practically zero. As the limb passes through the arc of abduction to

the horizontal, the working strain upon the muscles is progressively increased until at the horizontal position the work of maintaining elevation is greatest, and the associated strains are greatest at the shoulder, and on the short lever. Where muscles are affected by an atrophy of disuse, and have lost their efficient contractile power, it becomes apparent that, as the work increases, the muscles have to work at an increasing disadvantage from two sources, an increasing weight, and diminishing efficiency. So much for the lever of the limb. I will deal with the muscle quality later.

The scapula furnishes an indirect attachment for the bones of the upper limb to the trunk through its articulation on one hand with the humerus, and on the other by its clavicular and muscular attachments to the body. When the normal shoulder reaches the horizontal in abduction, the scapula and humerus become essentially one, and the scapula then takes on the part of the short proximal lever, and by this substitution much greater leverage is secured for the use of the muscles moving the limb. The buried position of the scapula under soft tissues is a great disadvantage in many ways. The casual examiner is apt to overlook the fact that movement in certain directions of the upper limb may be made with the scapulohumeral joint quite fixed. To one seeking to determine the amount of movement in the latter joint, or to increase its function by muscular stretching, the scapula affords very little for the hand to grasp. This is quite in contrast to joints where there is a long bone proximal and distal which can be easily grasped to produce passive movements or register degrees of function.

The scapulohumeral joint is a true joint, has articular cartilages, ligaments, etc., and has the protective mechanism as stated by Hilton, who uses the circumflex nerve as an illustration of his law which is: "The same trunks of nerves whose branches supply the groups of muscles moving a joint furnish also a distribution of nerves to the skin over the insertions of the same muscles, and the interior of the joint receives its nerves from the same source." In this way, he explains the fact that an inflamed joint becomes rigid, because the same nerves which supply the interior of the joint supply the muscles which move that joint.[1] As the nerve supply of joints also are distributed to the peri-articular structures, peri-articular lesions will act in the same way as intra-articular ones.

A painful intra-, peri-, or extra-articular lesion of the shoulder will produce a protective spasm of the muscles controlling its movements. If this spasm is maintained, the muscles develop contracture. Pain causes muscle spasm, muscle spasm produces more pain, hence more muscle spasm. The vicious cycle is broken by overcoming the spasm in the muscle by traction.

The scapulothoracic joint is not a joint, as it has none of the structures which enter into joint formation, neither has it this protective mechanism, although the movement between the scapula and chest wall is far greater than that of many joints in the body.

I turn now to the muscles which enter into our picture. These, I believe, are the great, if not the greatest, factors in the impaired shoulder function.

Muscles are of little use in activating an ankylosed joint, but they are of great service to the impaired joint. As it is with the latter we are dealing, the importance of preserving muscle function for the purpose of aiding in the preservation and restoration of disturbed function of the shoulder is of prime importance. Many of the principles applied to the shoulder-joint seem to hold good for most other joints in the body to which I have had an opportunity to apply them.

An intra-articular, peri-articular, or extra-articular painful process in or near the scapulohumeral joint will, through the joint's protective mechanism, put the muscles moving this joint into spasm; but not those of the scapulothoracic joint, as the latter has no protective nerve mechanism. This may be voluntary, but is mostly involuntary. When this spasm is maintained for a sufficient period of time, the muscles in spasm go into contracture. Muscles which are not under traction, or whose normal tone is not overcome by their antagonists, or are not kept in voluntary movement even to a slight degree, tend to develop this contracture. A simple and familiar illustration is the dropped foot of the polio case, or the plantar flexion of the foot in improperly treated cases of fracture of the femur or leg.

I am led to believe that muscles about the shoulder-joint, in a state of contracture, are painful, though I know of no other example in the body. The reason for this pain, I have not been able to explain to my satisfaction. The best explanation I have is, that it is a myositis of some form; but I feel most certain, from my observations, that the pain which accompanies muscle contracture about this joint is relieved by stretching these muscles to the proper degree. If the contracture is causing pain when these muscles are restored to normal, or near normal length and function, the pain is usually gone. This of course premises that the original condition which instituted the contracture has been cleared up.

An example of the extra-articular lesion is the stiff shoulder that is left after a Colles's fracture, where there has been no injury to the shoulder; but the patient has endeavored to immobilize the forearm by splinting the shoulder.

The best example of a peri-articular lesion is the simple, acute, subacromial bursitis which, if given rest by appropriate treatment, leaves no after effects; but if the patient has to prevent movement and pain in the shoulder by muscle spasm, when the bursitis is well, an impaired shoulder is left from muscle contracture with pain referred to the insertion of the deltoid.[3]

One of the common causes of impaired function of the shoulder is the treatment of fractures of the humerus in a way that maintains the humerus at or near the side of the body. Treated in this position, the adductor group of muscles develop atrophy of disuse, and also go into contracture. The elevator group, deltoid and supraspinatus, develop atrophy of disuse also, but not contracture, as they of necessity remain at their extreme length.

When one compares the relative bulk or cross-section of the muscles which hold the arm at the side, and which are shortened, with the cross-section of

the group of elevators which are atrophied and long, it is seen that cure is handicapped at the start. Movement to a slight degree of the adductors in a sling will restore their quality rather quickly, but not necessarily their length, because there is nothing to pull against them, whereas the elevators have length and are not contracted and have rather infrequent activity to restore their quality. When they do act, they act against the more powerful short adductors and gravity, together with the surperimposed disadvantage of the lever principle spoken of before.

When the arm has been held in abduction with or without external rotation, the reverse of this condition exists. The elevators are contracted, the adductors are lengthened, and when the arm is released from its outside support, gravity exerts a beneficent action and the long lever and weight of the arm is an advantage in stretching the elevators.

In examining cases of impairment one will notice that there is a certain range of motion in the joint of a few degrees in certain directions. This seems to be brought about by the natural position of repose of the arm during treatment for shoulder or other lesions. If the forearm rests against the body, the latter prevents internal rotation, and the slight amount of abduction present does not permit the humerus to be abducted sufficiently to develop any more. There are usually a few degrees of external rotation and abduction, and extension forward. The presence of this small amount of movement without pain, in different directions, is very helpful in differentiating between muscle and bone fixation, and intra-articular changes. This slight movement appears to be maintained by true muscular activity in a zone of small size which has a minimum of pain. Recovery is manifested by an enlargement of this non-painful zone and appears first in the direction of movements of necessity and frequency.

Ligaments are for stopping extremes of motion and guiding fixed movements. The shoulder-joint is devoid of ligaments for guiding fixed movements. Fixed movements are determined by groups of muscles so coördinated as to determine movement of the arm in fixed planes, thus acting as guiding ligaments. The planes in which arm motion at the shoulder takes place are almost infinite. This necessitates that there must be an infinite number of positions which the muscles assume to allow and determine the planes through which the arm passes. For the arm to make a movement in any plane, one has to conceive that there is a group of muscles acting as fixation muscles, and a group of muscles acting as activating or movement muscles. I use these terms which are relative only to aid in forming a concept as to any movement of the shoulder-joint. All the muscles must act, but those producing the movement in any non-curving plane must of necessity contract and extend to a greater degree than the muscles which are determining the position of the plane of movement. This aids in visualizing movement in a non-curved plane, but the shoulder-joint is capable of movement in not only simple planes, but curved ones.

When movement in a curved plane takes place, one can readily see that a

more complex action occurs. As a simple example, where the arm is abducted to the horizontal, leaving out the action of the scapula, it is raised by the deltoid and supraspinatus contracting, while the muscles which ordinarily depress it, subscapularis, pectoralis major, latissimus doris, teres major, are relaxing to permit the upward movement. At the same time these muscles are acting, the plane of motion is determined by the other group of muscles acting as guiding ligaments, and in this instance a portion of the guiding or fixation muscles are aiding in the work as movement muscles. In other words, there are muscle groups which during movement of the arm in one plane act like the lateral ligaments of a joint which has only one plane of movement. The next instant these same muscles have given up their fixation function and are acting as the groups which move the limb in an entirely different plane. If one will visualize vertical and horizontal planes of movement of the scapulohumeral joint at right angles to each other, one can readily appreciate that in circumduction through various angles or curves, there is a gradual transition in the action of these two contrasted groups of muscles at every degree of the arc of movement. This calls for a coördination between the group contracting to make the greater part of the movement, its antagonists, and the groups acting in the movement as fixation muscles or ligaments, each taking on the work of the other as the action progresses. In circumduction the complexity of this coördinating mechanism and its swiftness of action in rapid movements, as pitching a ball, is a thing to marvel at, especially when the direction of the pitch is under control. In a joint of such complex mechanism, a slight degree of contracture will interfere very quickly with function.

With the above principles in mind, it remains to use them if we can to prevent conditions which may arise in proximity to or outside the shoulder which tend to impair its function. To make use of these principles in preventing prolonged stiffness of the shoulder, one has to divide the problem into several classes.

A temporary extra-articular process distant from the joint in which the patient aids the comfort of the afflicted part by holding the shoulder in spasm to immobilize the limb, requires that the painful process be adequately splinted and the forearm be supported by a sling; that the patient be instructed to elevate the limb to its full vertical position as many times daily as is necessary to prevent contracture of the shoulder developing from protective spasm. This class includes infections of the hand and forearm, fractures of the same, certain processes in and about the scapula, as bursitis and spurs.

In peri-articular lesions in proximity to the scapulohumeral joint which are painful and produce as much pain and spasm as intra-articular ones, a choice of procedures is afforded depending upon the severity, duration, and disability of the process. These measures are either ambulatory or non-ambulatory. Distinctive of this type are the acute inflammations of the brusæ about the joint or the unexplainable lesions which cause the "irritable shoulder of Lovett".

I use for the treatment of these a simple bandage sling, large axillary pad,

and encircling swathe which embraces arm, body, and sling. If spasm has been instituted by the time I first see the case, and it is causing pain which can usually be determined in the examination by the relief afforded by holding the wrist in one hand and exerting gentle traction on the humerus, I use a form of ambulatory traction in conjunction with the sling, pad, and swathe. (See Fig. 1.)

In certain cases where the trapezius muscle has become too irritable, this traction is contraindicated. The weights used in this form of traction must be proportioned to the musculature of the shoulder, usually a pound or two is sufficient. If the weights are too heavy, they will bring about pain in turn. This traction is arranged so that gravity is used by day, and a traction weight at the end of a cord acting through a pulley on the foot of the bed, is used at night. (See Fig. 2.)

FIG. 1.—Showing axillary pad, sling and swathe, together with arrangement of traction weight attached to traction straps by buttons and button holes, for use in walking about.

For patients confined to bed this form of night traction is very desirable and comforting. A patient sitting or walking usually has comfort by day from the weight of the arm acting as traction, while his nights are miserable due to his attempts to move a long heavy horizontal lever by a short painful one. Where existing conditions necessitate that the treatment be non-ambulatory, or in treating cases of fracture of the greater tuberosity, or non-impacted ones of the surgical neck where abduction is indicated, as emphasized by Santee, I use the overhead suspension of the forearm, and traction on the arm with it in abduction.

I recently have treated a fracture of the clavicle in a temperamental actress by abduction with traction, and found that she could not stand the traction after a ten-day period. The abduction was continued, but when this was removed she had quite marked contracture which lasted for an appreciable time, whereas a comminuted fracture of the clavicle treated previously by this method proved quite effective and satisfactory.

These contrasts demonstrate that the question of treatment in my mind is still unsolved. The group of cases one sees where the primary trouble which initiated the contracture has cleared up sufficiently for the pain of the primary lesion to have disappeared, but has left the shoulder with a loss of function, and in some cases pain from the secondary process requires more consideration.

The diagnosis is made on a careful history and examination. The movements should be very slow and gentle. The scapula should be steadied with one hand while the other grasps the elbow and rotates the humerus gently. If there is any motion in the scapulohumeral joint the degrees of free painless movement existing in all directions should be compared with the normal side. Presence of this motion tends to exclude ankylosis.

The examination should include having the patient turn his back to the examiner, then abduct and elevate both arms as the examiner holds the lower angles of the scapulæ between the thumb and index fingers. This contrasts the action of the scapulohumeral and scapulothoracic joints of both arms

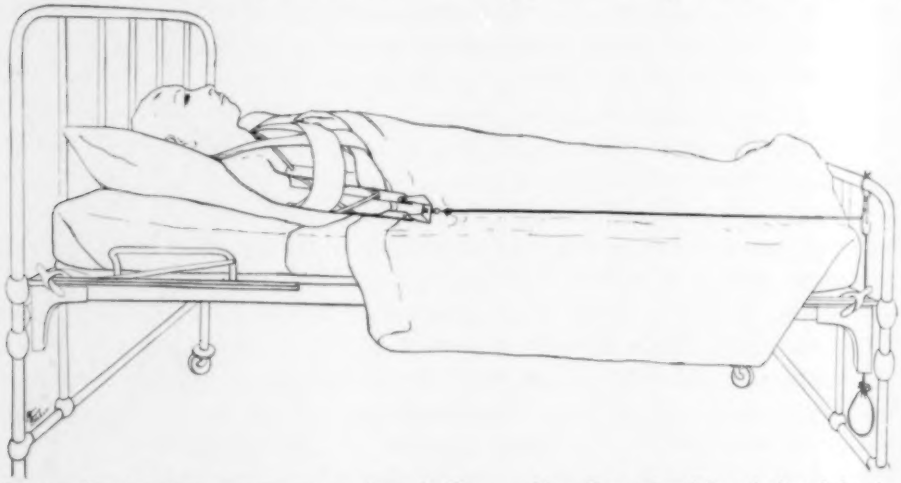

FIG. 2.—Showing same arrangement as shown in Fig. 1, with pulley and weight substituted for day weight, when patient is lying down. The buttons facilitate this change.

simultaneously. In the examination of the patient, if there is any abduction present, resisting this movement as it is made with slight pressure by the examiner will necessitate that the patient involuntarily fix the scapula before he can exert any antagonistic pressure. In these cases pain is usually referred to the site of insertion of the deltoid. If traction on the elbow relieves this pain, it is significant that it is caused by muscle spasm or contracture. The patient is placed in the supine position on the examining table, the anterior border of the scapula is fixed with one hand while the arm is very gently and as slowly as possible moved in a sagittal plane with the forearm flexed over the operator's forearm. This is painful and should be done for diagnosis to a very slight degree only. This tells the operator degrees of movement, whether the muscles stretch at all, and if they do, how much; the degrees of resistance of the muscle and the muscle's quality. There may be very definite movement in certain directions, as mentioned before, greater than in others, and it can be determined easily that movement is limited by muscle contracture.

When the history and X-ray exclude articular or marked peri-articular bone changes, together with the examination confirming that loss of function is due to muscle contracture alone, part of the treatment is by gentle stretching of the contracted muscles. This should be done once or twice a week by

the surgeon, and must be done in the direction of the normal movements of the shoulder. The range should be done just beyond the point of pain, and care should be taken not to go too far, or a bad reaction will occur. The movement must be done so slowly that it is barely appreciable, to satisfy a physiological law.[4] The patient must be directed to relax, and this is a difficult thing to accomplish. If the surgeon feels the muscles giving, followed by a slight contraction of the muscles, which will cause pain, relax the muscles by retracing the movement a few degrees, until spasm ceases, then proceed. Many times slight crepitation will be felt as if something has given away. The operator should endeavor to maintain traction on the humerus while performing these movements. The arm should be returned to the position of repose not too fast, and then traction on the humerus for a few moments will relieve the pain and give the patient confidence to permit stretching in another direction. These movements I have never done under an anæsthetic, as in one of Codman's early papers,[2] he called attention to the great damage and disability produced by doing too much.

The reaction to stretching should be very moderate pain at the time it is done. This should not persist, but leave a slight soreness which passes away in a few hours, while the pain at the insertion of the deltoid, in the neck, and down the arm is usually improved together with slight improvement in the function of the joint.

In the treatment of the contracture of any group of muscles of any joint without bone changes, in which there is some movement, resisted movements in the direction of the plane in which movement has been lost will tend to restore function by developing the muscle or muscles which produce it by contraction, and at the same time will by coördinated synergistic action tend to relax the antagonists. As movement develops in the joint, resisted movements following this dictum will be of material aid.

Exercises at home in conjunction with the above are swinging the dependent arm by body movements, as a pendulum, with the body bent forward at the waist. These should at first be within the point of pain, then slowed to require voluntary muscle movement of scapulohumeral muscles. Small weights may be used later, and control of scapular action by an attendant is desirable. Wall climbing by the fingers and hand, or climbing a small suspended ladder by the fingers, using the muscles of the forearm only and making little attempt to use the elevators until they have gained some of their contractile power. When the hand has reached an elevated position, it can then be used as a fulcrum to stretch the adductors. The arm should not be dropped quickly to the side after this movement, but returned slowly to prevent reflex protective spasm.

The principle of stretching the shoulder by elevating the hand by a cord and weight acting over a pulley is excellent as a means of stretching contracted muscles, but the contracted muscles should not be permitted to pull the weight back. This principle can be used to give resisted movements in various directions as the best adjuvant to the stretching.

In cases in which it is desirable to aid the group of elevators or abductors to develop by active movements during a minimum of work, I have the patient lie down on his back, the arm is then suspended in a sling supporting the weight of the arm as it rests at his side. The suspension point of this sling must be high to give the sling a long arc of movement. The patient then can move the arm laterally, or abduct it without having to support its weight.

For the pain that is present in so many of these cases that they are frequently diagnosed as neuritis, I find aspirin and phenacetin combined most helpful.

Local Measures.—Nothing in my experience compares with hot moist stupes, applied very hot over the whole shoulder and upper arm for twenty minutes each day.

Massage Is Next.—This must be given with the greatest gentleness to the painful cases, and not too frequently. I have seen these cases made distinctly worse by what the masseuse thought was "gentle massage". Massage should be given after the moist heat. Massage is best given every other day. Dry heat comes third in efficiency for pain.

Electricity.—In the form of diathermy has been disappointing to me, though I am still open to conviction, and am still trying it.

Recovery from the shoulder disabled by muscle contractures is so slow and tedious, that anything which can be done to prevent it should be instituted early. Although I attempt to do this in every case which I anticipate may develop this condition, and keep it constantly in my mind, and although I believe I avoid a great deal of trouble, I cannot secure perfect results in all cases. One understanding these principles and making use of them, I believe, can restore function more quickly to a shoulder than where they are not used.

In the course of treatment, I have found the following very trying: Noncoöperative patients, ignorant patients, rheumatic tendencies, weather changes, occupational strains, and find one has to adjust and arrange the administration of treatment according to the reactions that develop from these factors.

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INJURIES TO THE ABDOMINAL VISCERA

THEIR RELATIVE FREQUENCY AND THEIR MANAGEMENT*

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There are two types of injury to the abdominal viscera: *First*, those produced by direct trauma such as blows, falls and automobile accidents; *secondly*, those resulting from penetrating objects such as gunshot and stab wounds. This latter group will not be discussed in this paper, as it is generally agreed that this type of injury needs immediate surgical attention. In the cases of traumatic abdominal injury one is confronted with making a differential diagnosis between: (1) Retroperitoneal hæmorrhage; (2) intra-abdominal hæmorrhage; (3) rupture of a hollow viscus. On the Fourth Surgical and the Children's Surgical Service at Bellevue Hospital there have occurred, during the past nine years, fifty-three cases of injury to the abdominal viscera. These injuries will be grouped under the three headings just given.

Retroperitoneal Hæmorrhage.—There are two causes of retroperitoneal hæmorrhage: First, ruptures of the kidney, accompanied by retroperitoneal hæmorrhage, which have resulted from laceration of the kidney substance. Second, cases of retroperitoneal hæmorrhage, which have resulted from injuries to the retroperitoneal tissue without a kidney lesion.

Ruptures of the Kidney.—This series included eighteen cases, seventeen of which were not operated upon, and sixteen of the seventeen cases were cured. The average stay in the hospital was thirteen days. One patient, seventy-four years of age, with a fracture of the right radius and ulna, a fracture of the fourth cervical vertebra, and a rupture of the left kidney, was not operated upon and he died twenty-four hours after admission. There was one operative case, a child, ten years of age, who had fallen four stories and had received a compound fracture of the right humerus and abdominal injuries. Operation revealed a laceration of the right kidney with retroperitoneal hæmorrhage. Nephrectomy was done and the patient died twelve hours later. One case in this group, a boy, nineteen years of age, having fallen down an elevator shaft, received a fracture of his right wrist, right ankle, and a rupture of his right kidney, and forty-eight hours after admission his abdomen became distended and rigid and his complaints were referable to his abdomen. Conservative treatment was followed and forty-eight hours later his abdominal symptoms disappeared and the patient made an uneventful convalescence.

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Retroperitoneal Hæmorrhage without Kidney Injury.—This series included two cases; one patient being a child, twelve years of age, who had been hit by an automobile. The urine findings were negative. A diagnosis of intra-abdominal injury was made and laparotomy performed, disclosing a retroperitoneal hæmorrhage without hæmorrhage in the abdominal cavity. An uneventful recovery followed. The second case was that of a child, five days old, who had been a difficult breech extraction, with Erb's palsy of the left arm. Examination revealed a mass the size of a lemon in the right side of the abdomen. There was no visible peristalsis and on rectal examination the mass could not be felt, nor was blood detected. A pre-operative diagnosis of intussusception was made and on opening the abdomen the right kidney was found torn loose with a retroperitoneal hæmorrhage. The peritoneum had been torn posteriorly and some blood clots, about a cupful, were present in the abdominal cavity without active bleeding. The abdomen was closed in layers and the patient died two hours later.

Cases of retroperitoneal hæmorrhage may produce symptoms simulating abdominal hæmorrhage, or the rupture of a viscus. In making a diagnosis it is very important to consider the site of injury, and if the injury has been over the kidney, or lumbar region, one should suspect a retroperitoneal hæmorrhage as a most logical diagnosis. Of course, if there is hematuria one can be more certain of the diagnosis. Apparently, the retroperitoneal hæmorrhage stimulates the sympathic nervous system causing a paralytic ileus with the symptoms referred to the abdomen. In cases of rupture of the kidney, or in retroperitoneal hæmorrhage without kidney damage, conservative treatment is the treatment of choice.

Intra-abdominal Hæmorrhage.—There are usually two causes for hæmorrhage in the abdominal cavity. It is due either to rupture of the liver or to rupture of the spleen.

Ruptures of the Liver.—There were seven cases of rupture of the liver in this series, and of this group four were operated upon, with two deaths. In the operative cases no active bleeding was found at the time of operation, but the abdomens were found full of blood clots. In the two cases that died, each had a pre-operative diagnosis of ruptured liver. One patient, thirteen years of age, was admitted in marked shock, with a blood pressure of 60. A transfusion of 250 cubic centimetres of blood was given and the blood pressure raised to 90/60. The patient was operated upon and blood pressure fell to 64. There was no active bleeding at the time of operation and he was transfused with 400 cubic centimetres of blood immediately following operation and the blood pressure was again raised to 90, but the patient died twelve hours later. Another patient was a man, forty-five years of age, in moderate shock with pre-operative diagnosis of rupture of the liver. An exploratory laparotomy was performed, but no active bleeding was found at the time of operation and the patient died ten hours later. There were three cases which were not operated upon, two of which lived and one died. One patient was a child, seven years of age, who had been struck by an automobile, and was in marked shock with thready pulse and board-like abdomen. The patient had projectile vomiting and dulness over the right lower quadrant. A diagnosis of ruptured liver was made and the patient was not operated upon. After three days his abdominal symptoms had mostly disappeared. He remained in the hospital ten days and was discharged cured. The second case was a man, thirty-two years of age, who had been

struck in the abdomen. He stayed in the hospital four days, but went home at his own request, with instructions to remain in bed. The patient returned in two weeks with a swelling in the region of the ninth rib. He was operated upon and found to have a hæmatoma with a laceration of the liver. An uneventful recovery resulted, the patient leaving the hospital on the seventh day. The case that died was a child, three years of age, in extreme shock, who died one hour after admission. Post-mortem examination revealed a rupture of the liver, of the left kidney, and of the spleen.

Ruptures of the Spleen.—This series included eight cases with three cases operated upon, all of which lived. One patient, twenty-eight years of age, admitted twelve hours after having been struck in the left upper quadrant by a policeman's night stick, came in complaining of pain in the left upper quadrant. A diagnosis of injury to an abdominal viscus was made. The patient was operated upon twenty-hours after the injury. The abdomen was found filled with blood clots and the spleen ruptured, but no active bleeding at the time of operation. Splenectomy was done and the patient recovered. The second case was that of a man, thirty-five years of age, who had been intoxicated and did not know what had happened to him; but he had been injured in some way the night before. He was admitted fifteen hours after his alleged accident with pain and rigidity, chiefly on the left side of the abdomen. A diagnosis of injury to an abdominal viscus was made. An exploratory laparotomy was performed, the abdomen found full of blood clots and the spleen ruptured. There was no active bleeding at the time of operation. Splenectomy was done and the patient recovered. The third case was that of a boy, thirteen years of age, who had been hit in the left upper quadrant by a baseball bat. He was admitted to the hospital immediately, in shock, and an emergency operation performed, the spleen being found ruptured with active hæmorrhage. Splenectomy was done and the patient cured. There were five cases not operated upon, all of whom died; but in each case there were multiple injuries. One patient, eight years of age, suffering from a fracture of the left femur and of the right humerus, died a few hours after admission. The second case, three years of age, in extreme shock, died a few hours after admission. Post-mortem revealed a rupture of the spleen and diaphragm. The third case was a man, fifty years of age, alcoholic and in extreme shock, who died twelve hours after admission. Post-mortem examination revealed a ruptured spleen and left kidney, retroperitoneal hæmorrhage and, also, a fracture of the sixth and tenth ribs on the left side. The fourth case, a boy, nine years of age, in marked shock, died a few hours after admission. Post-mortem examination revealed a rupture of the spleen and kidney. The fifth case, a child, three years of age, died thirty minutes after admission. Post-mortem revealed a ruptured liver, spleen, and diaphragm.

Hæmorrhage in the Gastrocolic Omentum.—This case was a man, twenty-five years of age, with a history of having been struck in the abdomen by a blackjack twenty-four hours before admission. Next day he complained of pain in the abdomen and was admitted to the hospital and operated upon for a rupture of an abdominal viscus. The patient was found to have a hæmorrhage in the gastrocolic omentum, with no evidence of injury to other abdominal organs or active bleeding at the time of operation. Six days after the laparotomy the patient eviscerated, was resutured and died two days later.

In cases of intra-abdominal hæmorrhage one is aided in making a diagnosis if a history can be obtained as to where the blow was received, as will be noted in ruptures of the spleen. In most of the ruptures of the liver the patient complained of pain in the right upper quadrant, which frequently was accompanied by fractures of the ribs on the right side. One should always try to detect the presence of liver dulness, as this is one of the aids in differentiating between intra-abdominal hæmorrhage and ruptures of a hollow viscus.

Treatment.—In ruptures of the liver conservative treatment is more desirable than an exploratory laparotomy, as surgery is of no avail in ruptures of the liver, for usually the hæmorrhage has stopped and is started again by the surgical intervention. In ruptures of the spleen I think that one can see from this small group that two of these cases would have made an uneventful convalescence if they had not been operated upon, as the hæmorrhage had stopped before operation, the injury having occurred twenty-four hours before. I cannot help but feel that these patients should not be operated upon immediately, but should first be treated for shock and their general condition watched, and a laparotomy performed if their condition demands same.

Ruptures of a Hollow Viscus.—In these cases one is dealing with a rupture of either the intestine, the bladder or the stomach.

Ruptures of the Intestine.—There were twelve cases in this series, and of this group two patients were not operated upon, one being a man, sixty years of age, in extreme shock, who died fifteen hours after admission. Post-mortem examination revealed a rupture of the small intestine and fracture of the base of the skull. The second case was a woman, forty years of age, who had been struck by an automobile twenty-four hours before admission. She was treated by a private physician and referred to the hospital twenty-four hours later and died a few hours after admission Post-mortem examination revealed a rupture of the jejunum, fractured tenth left rib and laceration of the pleura. There were ten cases that were operated upon, three of which lived and seven of which died. Of the three cases that lived, two had been injured twenty-four hours before operation, and in all three cases the rupture was found in the ileum. Of the seven cases that died, all were admitted and operated upon immediately. Ruptures were found in the transverse colon in one case, in the jejunum in one case, in the ileum in four cases, and in another case the records merely stated small gut.

Ruptures of the Bladder.—There were four cases in this series, with one cure and three deaths. One patient was a man, thirty-three years of age, who had been kicked in the lower abdomen by a horse. He was admitted to another hospital and discharged the same day, but after being discharged from the other institution he complained of frequency of urination and passing only a small amount of urine at a time. On admission to Bellevue Hospital he complained of pain, as well as frequency of urination. Examination revealed definite fulness over the left lower quadrant and only a few cubic centimetres of urine obtained on catheterization, with hematuria. A diagnosis of extraperitoneal rupture of the bladder was made and the patient was operated upon and a rupture found near the base of the bladder. A superpubic drain was inserted and a cigarette drain at the site of rupture. The patient made an uneventful convalescence, being discharged on the sixteenth day, with the suprapubic wound healed. Of the cases that died, one had a rupture of the bladder and small intestine, and a fracture of the skull, and was brought in unconscious. He was operated on forty-eight hours after admission and died twenty-four hours later. The second case was a man, fifty-six years of age, who had been intoxicated and did not know how he had been hurt, but complained of pain and swelling in the lower abdomen. He was operated upon and found to have a rupture of the bladder with diverticulum of same. The third case, forty-three years of age, fell down an elevator shaft receiving a fracture of the pelvis and a fracture of the transverse process of the lumbar vertebra I saw this patient immediately on admission and suspecting a rupture of the bladder advised immediate catheterization, but this was advised against by a urologist, as he felt the patient had a cord injury. The patient was operated upon after twenty-four hours for a ruptured bladder, but he developed an extensive osteomyelitis of his pelvic bones and died ten months later.

Ruptures of the Stomach.—One patient, six years of age, was admitted to the hospital immediately after being hit by an automobile. An emergency operation was done and the patient found to have a rupture at the cardiac end of the stomach which was repaired by simple closure and the patient died a few hours later.

In the diagnosis of rupture of the intestine one is confronted with a very difficult problem, but if the injury has been directly over the abdomen without injury to the ribs or the pelvis, it should make one suspicious of a rupture of the intestine. One should try to detect the absence of liver dulness, and in these cases X-rays of the abdomen should be taken to determine the presence of gas. In cases of rupture of the bladder the location of the injury is of considerable aid, and if the trauma has been directly over the pubis, or if there is a fracture of the pelvis, one should be suspicious of a bladder injury. Of course, catheterization of the patient is important, particularly if the bladder is filled and the fluid is not withdrawn, or if bloody urine is obtained. It is well to remember that one can have intra-abdominal rupture of the bladder and the catheter inserted into the abdominal cavity and the same amount of fluid withdrawn as is introduced. Treatment of rupture of the intestine, of course, requires immediate surgical intervention, but one should be reasonably certain that he is dealing with a ruptured intestine before submitting the patient to a laparotomy. If there is a question of doubt, it is to the patient's interest to follow the policy of watchful waiting, rather than submit him to an exploratory operation.

In the treatment of rupture of the bladder one is justified, if in doubt as to the diagnosis, in making a suprapubic exploration, for this can be done under local anæsthesia without doing the patient any particular harm, while cystoscopic examination in these patients is very painful and shocking and does just as much damage as a suprapubic incision.

Injuries to the Chest Simulating Abdominal Injuries.—I have not included chest injuries in this report, but I would like to call attention to the fact that ruptures of the lung, with pneumothorax, will produce symptoms which are referred to the abdominal cavity, and these patients are frequently explored with negative findings when at autopsy a correct diagnosis is made. This can be avoided if one makes a careful physical examination, or takes X-rays of the chest. Dr. Fenwick Beekman has stressed this point in a recent paper which is to be published, and I refer those who are interested to his paper.

Palliative Treatment of Abdominal Injuries.—There is an element of danger in the use of blood transfusions in this type of case, particularly if the patient is given large transfusions of 500 to 800 cubic centimetres. Needless to say, the transfusion is given rapidly and the blood pressure is raised suddenly and in so doing the blood clots may be dislodged. If transfusions are employed the patient should not be given over 250 to 300 cubic centimetres at a time, and this may be repeated if necessary. On the Fourth Surgical Division at Bellevue Hospital we have been using, for the past year and a half, the gum glucose solution as used at the Woman's Hospital. This consists of 6 per cent. gum acacia and 20 per cent. glucose in 500 cubic cen-

timetres of saline, given at the rate of 4 cubic centimetres per minute, at a temperature ranging between 102° and 105°, or in other words, taking two hours to run in 500 cubic centimetres of the solution. This has given very satisfactory results and has a field of usefulness.

CONCLUSIONS

1. Cases of retroperitoneal hæmorrhage may simulate intra-abdominal injury, but with the aid of the history and the location of the injury, the diagnosis should be made. These cases, of course, should never be operated upon.

2. In cases of intra-abdominal hæmorrhage, if the hæmorrhage is due to a ruptured liver, conservative treatment should be followed, and in cases of rupture of the spleen the patient should be observed and treated for shock, and operated upon only if there are signs of continuous bleeding.

3. In cases of rupture of a hollow viscus, immediate surgical intervention is essential, but one should not submit these patients to a laparotomy unless he is certain of the diagnosis, as an exploratory laparotomy does not serve the patient's best interest.

ACUTE PANCREATITIS

AN ANALYSIS OF EIGHTY-EIGHT CASES WITH ESPECIAL REFERENCE TO DIAGNOSIS

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Acute pancreatitis can be diagnosed before opening the abdominal cavity. Fitz indicated that this abdominal catastrophe should be suspected when violent epigastric pain is followed by vomiting and collapse. These, however, are fulminating cases. The conception that acute pancreatitis can be diagnosed only at necropsy, or at the operating table, is no longer tenable. The possibility of acute pancreatitis, if borne in mind whenever an acute upper abdominal mishap presents itself, offers no greater difficulty in diagnosis than any other acute surgical condition.

Attention to the symptomatology of these eighty-eight cases herein reported may be of value in crystallizing the outstanding signs, the better to diagnosticate this condition. Early diagnosis leads to better prognosis, for in the two series previously reported,[1] the mortality rate dropped from 62 to 17 per cent. Seventy-five per cent. of the latter group was diagnosed pre-operatively.

Etiologically, acute pancreatitis may result from (1) pyemic involvement; (2) by contiguity; (3) by lymphogenous extension; (4) retrogression of bile into the pancreatic duct; or (5) regurgitation of duodenal contents into the duct of Wirsung.

Pyemia seems to play little or no rôle, for early isolation of bacteria has never been accomplished. Extension by contiguity from gastric or duodenal ulcer may occur, but acute pancreatitis is very infrequently encountered with these changes. In our eighty-eight cases no mention was made of any pathological lesions in these organs, but the realization that many cases did not allow of complete exploration must be remembered.

Experimentally, the injection of enterokinase into the duct of Wirsung produced acute pancreatitis. However, the probability of this modus operandi must be exceedingly rare, notwithstanding the work of Williams and Bush. These investigators observed post-mortem dilatation of the biliary orifice as though it had been recently traversed by a stone. By dilating the biliary orifice of dogs by the passage of glass balls, they produced pancreatic necrosis. They concluded that regurgitation of intestinal contents may also be responsible for the production of pancreatic necrosis.

Infection of the pancreas via the emphatics as propounded by Maugeret, Arnsperger, and Deaver is based on the contention that the pancreatic lymphatics bear a very intimate relation with those of the biliary tract; secondly, on the fact that enlarged lymph nodes are found about the head

of the pancreas in acute inflammations of that gland; and, lastly, that anatomically regurgitation of bile into the duct of Wirsung can occur in but two of the four varieties of papillæ of Vater embryologically possible.

The lymphogenous hypothesis carries with it the assumption, however, that infection spreads against the stream and directly through the lymph nodes. Infection does not run up stream, nor does it break the locks of lymph nodes. Experimentally, Archibald observed enlargement of lymph nodes by injecting bile into the duct of Wirsung. Swollen nodes would in all probability prevent the spread of infection from the gall-bladder to the pancreas and vice versa. Bartels maintains that no intervening lymph nodes connect the biliary passages and pancreas, and Nordmann was unable to produce any pancreatic changes by introducing bacteria into the gall-bladder after tying off the common duct.

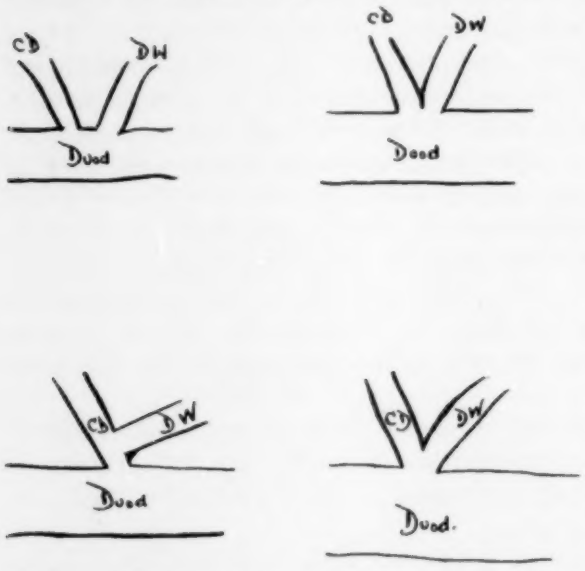

CHART I.—Illustrates the four varieties of papillæ of Vater.

Retrojection of bile into the pancreatic duct resultant pancreatitis was first observed by Opie at autopsy. A small calculus had lodged in the diverticulum of Vater, thereby forming a common passageway of the ductus choledochus and the duct of Wirsung. Bile-stained fluid was present in the pancreatic duct, for the stone had prevented the influx of the bile into the duodenum. He then produced the disease experimentally by injecting bile into the duct of Wirsung. Infected bile he found more active than normal bile. Flexner showed that it was the bile salts that were the activating agents in the production of necrosis, and that mucus greatly inhibited the activity of bile. Infected bile induced fulminating pancreatitis.

Nevertheless, the mechanism of retrojection where no calculi were found in the ampulla still remained unexplained. Archibald showed that spasm of the sphincter Oddi could withstand pressure greater than that issuing from the biliary tract. Pancreatic lesions were produced by the temporary physiologic closure of the sphincter with spasmodic damming back of bile into the pancreas. Application of hydrochloric acid to the duodenal orifice of the ampulla produced prolonged sphincter spasm, so that fluids could be forced into the pancreatic duct by increasing the pressure in the biliary passages. This observer believes that bile frequently enters the pancreatic duct without

much damage. To produce pancreatitis, bile must be infected, the proportion of biliary salts increased, or normal bile under considerably increased pressure. Nordmann purse-stringed the ampulla with resultant jaundice and biliary tract dilatation, but produced no pancreatic involvement. We may assume, therefore, to induce pancreatitis not only must bile be infected, but an increased biliary pressure must be counterbalanced by unusual sphincter spasm.

Acute pancreatitis is not a primary disease, but rather a sequela. Whether we favor one or the other hypothesis in its production, we must face the fact that biliary disease is usually the precursor. It is more than mere coincidence that Egdall found biliary calculi in 50 per cent. of his cases and 75 per cent. complained of gall-bladder symptomatology. As for the few cases in which no biliary pathological lesions or symptomatology was found, it is well to recall the work of Hess, who produced acute necrosis by tying the pancreatic ducts at the height of digestion, and that of Pratt, who did the same in fasting animals with no necrosis resulting.

In analyzing these eighty-eight cases, we have taken fat necrosis as a criterion upon which the diagnosis was based. It might be mentioned that acute pancreatitis with no fat necrosis resulting is a possibility, for we have encountered cases of acute pancreatic œdema with many other concomitant findings. We deemed it advisable, however, to include only those cases in which fat necrosis was demonstrable.

Females were affected in 88 per cent. of our cases. Our female-male ratio was the same in acute pancreatitis as in our gall-bladder disease, Reiser and Korte's observations to the contrary notwithstanding. The former observed males predominating 79 to 42, the latter 30 to 14. If we regard gall-bladder disease as the important factor in the etiology of pancreatitis, males and females are alike affected.

Fifty per cent. occurred in the fourth and fifth decades; the youngest was nineteen, the oldest seventy.

Previous gastro-intestinal disorders are of great significance. All but eight gave some history of "dyspepsia"; of these four had repeated alimentary disturbances for three to four weeks prior to admission. Fifty-three per cent. gave a definite history of biliary disease.

Pancreatic symptomatology in its acute manifestation depends on the activation of trypinogen into trypsin. Digestion of protein by this liberated enzyme, whether it be blood-vessels, lymph-vessels, or pancreatic cells, all share in the catabolic process. Pancreatic cells through digestion liberate lipase and, consequently, not only trypsin and lipase circulate through lymph channels, but their products of incomplete digestion as well.

Symptoms are, therefore, due to local pancreatic irritation, as well as those due to the circulation of toxic products. Inflammation of the pancreas results in œdema and swelling of that organ. Stretching of the pancreatic capsule induces pain. Diaphragmatic excursion may be obstructed. Biliary

drainage into the duodenum impeded. Pressure on the abdominal brain should be taken cognizance of in explaining acute pancreatic symptomatology.

Circulation of foreign protein and its products of incomplete digestion may in part explain the severe toxæmia some of these patients present. Digestion of blood-vessels contributes the hæmorrhagic features to the picture. Inflammation of the peritoneum to the irritants circulating under its serosa depicts the reaction of this membrane, and, finally, the whole picture *en masse* working simultaneously, presents a definite clinical entity that can be recognized.

Symptomatology.—Constant epigastric pain is most frequently encountered. Eighty-six of our series complained of epigastric pain, often described as splitting in character, as though something within were trying to force its way out. Some also complained of right hypochondriac pain, others of generalized abdominal pain. Ten had persistent backache. Backache was troublesome in fifty-eight of our cases. Left hypochondriac pain was present in thirty-seven cases.

CHART II

Pain in Acute Pancreatitis

Location	Number	Per cent.
Epigastric	86	97
Hypochondriac, right	59	67
Backache (left lumbar)	58	66
Hypochondriac, left	37	41
Generalized abdominal	17	19

Pain in acute pancreatitis is of intense severity. Frequently, morphia in repeated doses fails to alleviate it. It is quite interesting to note that patients often volunteer the information that a hypodermic failed to ease their discomfort, whereas previously relief was immediate with one dose of morphia.

Vomiting is a very troublesome and persistent complaint. It is never progressive. Eighty-five of our eighty-eight vomited. Emesis is never fecal in character, and can usually be relieved by a single gastric lavage, thus differentiating it from acute intestinal obstruction situated high up.

Foreign protein injected into the circulation calls forth a peculiar train of symptoms which has been designated allergic. These at times predominate in acute pancreatitis. Shock, collapse, cyanosis, dyspnœa, and in some instances dermatologic reactions, occur. Exactly how much pressure on the semi-lunar ganglion adds to the picture it is difficult to say, but these patients when seen early present an asthenia peculiarly characteristic of pancreatic disease. Cyanosis may in part be due to diaphragmatic embarrassment. Forty per cent. of our cases were cyanotic. Seventeen were in shock on admission.

Temperature *per se* aids us not at all in the diagnosis, for in twenty-nine cases it was normal. In but eight did it rise above 102 degrees Fahrenheit.

Quite interesting, however, is the temperature-pulse ratio, for we observe that the pulse rises out of all proportion to the temperature elevation.

Icterus due to pressure of the pancreas on the ductus choledochus is never severe. Twenty-eight were jaundiced and five others had bile in the urine, notwithstanding the absence of icterus in the scleræ or skin.

Peritoneal reaction due to the chemical irritants, trypsin and lipase, with their incomplete products of digestion circulating in the subperitoneal lymphatics, presents the same signs as peritonitis due to infection. This inflammation may be local or diffuse. Local peritonitis due to mechanical stretching of the pancreatic capsule by the œdema of that gland adds the local signs of tenderness to those due to the chemical irritant. Epigastric tenderness was present in 66 per cent. of the cases and left costovertebral in 32 per cent.

Chart III reveals where tenderness was elicited.

CHART III

Tenderness in Acute Pancreatitis

Location	Number	Per cent.
Epigastric	58	66
Hypochondriac, right	50	57
Hypochondriac, left	31	35
Costovertebral, left	28	32
Generalized abdominal	17	19

Constipation, and not diarrhœa, is the rule. The latter condition when present depicts a late manifestation, and one in which considerable pancreatic tissue has been necrotized. Constipation is not complete; of value in differentiation from intestinal obstruction. The silent paretic belly of acute pancreatitis offers a marked contrast to the one of mechanical obstruction in intestinal obstruction.

Other Symptoms in Acute Pancreatitis

Symptom	Incidence	Percentage
Cyanosis	58	66
Shock	17	19
Emesis	86	97
Abdominal distention	39	46
Jaundice	28	32
Urticaria	2	2.5

Every gradation of pancreatitis may be encountered. Three cases of different severity are cited below.

S. R., female, age twenty-three years, married, was admitted to the Jewish Hospital January 12, 1920 complaining of general abdominal and left lumbar pain. Pain started in the epigastrium and then radiated to the intrascapular region. Pain was associated with vomiting. The first attack occurred four months prior to admission. She had many minor attacks in the past two months. Since the birth of her child four months ago

the patient has experienced fulness and pressure in the epigastrium. Each attack was associated with dark-colored urine and light-colored stools. For the past four days the pain in the epigastrium has been knife-like, radiating to the back and intrascapular region, associated with feverishness and weakness, and necessitated an injection of morphin. Three hours later the patient experienced a similar attack which required another hypodermic of morphia. She was admitted with constant dull epigastric pain and vomiting. The bowels have been constipated. In all, four injections of morphia were administered. Pain still persists, but is not as severe. Physical examination discloses cyanosis with an icteric tinge to the scleræ. Patient is rather anxious. Looks "all in," asthenic. Tenderness elicited in right hypochondrium and right iliac quadrant, left costovertebral tenderness, and epigastric tenderness, with the sensation of a mass in this area. On opening the abdomen there was a gush of beef broth fluid (serosanguineous). The gall-bladder was normal in size. It appeared normal. No stones. Omentum granular, swollen, œdematous with considerable fat necrosis. Parietal peritoneum studded with areas of fat necrosis. Section of omentum removed. Pancreas drained. Pathological report showed omentum contained areas of congestion surrounding areas of fat cells. convalescence was uneventful except for three days of diarrhœa (eight to ten movements a day). Patient discharged in twenty-five days, recovered.

B. Z., female, age fifty-two years, married, complained of abdominal pain one year ago, had severe abdominal pain radiating to the back and shoulders, associated with vomiting, chills, and fever. Another attack ensued two months later. Attacks recently recurred every week or two. For the past month has had pain every other day. Vomited once on admission. On physical examination, no icterus or cyanosis was present. Abdomen distended. Tender in epigastrium and left lumbar region. Temperature, 100.8° F. Pulse, 88. Respiration, 28. At operation the gall-bladder contained many small stones. The gall-bladder was thin. Small amount of beef broth escaped. Fat necrosis on omentum. On opening the gastrohepatic omentum, the pancreas was found swollen and indurated. Cholecystectomy with drainage resulted in recovery in seventeen days.

I. C., age fifty-five years, male, married, had epigastric pain for many years. He was admitted complaining of severe epigastric pain for twenty-four hours. Pain was present throughout the abdomen. Vomited three times. On examination patient presented a picture of shock and asthenia; skin cold and clammy. Abdomen distended and tender throughout. Marked left costovertebral tenderness. Cyanosis of face and extremities. Temperature, 98.2° F. Pulse, 112. Respiration, 30. At operation considerable beef broth fluid in general peritoneal cavity and lesser sac. Omentum granular with considerable number of fat necrosis. Pancreas enlarged, hæmorrhagic, with large areas of necrosis. Pancreatic capsule incised and drained. Patient succumbed in twenty-four hours.

The diagnosis rests on the previous gall-bladder history which now presents a symptom-complex somewhat different than heretofore. Morphin no longer alleviates the pain, which now radiates from the epigastrium transversely to the left. The cyanosis, slightly icteric tinge of the scleræ or skin, together with the peculiar asthenia and dyspnœa, make the picture of acute pancreatitis. Tenderness elicited over the left upper quadrant and left costovertebral angle should aid greatly in confirmation of the diagnosis.

The differential diagnosis of acute pancreatitis must be clearly analyzed because it simulates so many other upper abdominal entities. Acute cholecystitis, particularly the suppurative variety, requires careful consideration. This is especially true where impending perforation and localized peritonitis may be present. We are here aided by the presence of a palpable mass which attaches itself to the lower border of the liver. Pear-shaped, globular, this

mass denotes a distended gall-bladder due to cystic duct block. Irregularity or bogginess of this mass may be caused by an adherent omentum protecting an impending blow-out or a perforated gall-bladder. Because of its superficiality, light palpation, by placing the palm of the hand on the abdomen with the patient breathing slowly and deeply, makes for easy disclosure of the mass. If an exudate extends into the subhepatic region, the patient frequently will limit perceptibly the respiratory excursions; abdominal breathing is lacking. Thoracic breathing is the rule. In these cases slight cyanosis of the face is present and is often mistaken for the cyanosis of acute hæmorrhagic pancreatitis.

Perforation of a diseased infected gall-bladder into the free abdominal cavity, with resultant biliary peritonitis, produces shock which may well simulate the shock of acute pancreatitis, but no difficulty should be encountered in differentiating the two because of the preëxisting gall-bladder story. Usually the patient had been confined to bed with an acutely distended cholecystitis, too frequently receiving so-called medical treatment in the hope that the cystic block, which may be due to stone or tumefaction, will subside and reëstablish drainage.

Erroneous is the contention that gall-bladders rarely perforate, for too often have such catastrophes resulted from procrastination. If the sudden onset of acute pancreatitis be borne in mind, together with the absence of the local findings above enumerated, differential diagnosis will not be so difficult.

Acute intestinal obstruction deserves our next consideration, for differentiation from acute pancreatitis, especially that situated high in the intestinal tract, may offer some difficulty. Although the shock encountered in the sudden snaring of a loop of gut by a band or aperture may be great, the abdominal findings are easily differentiated from acute pancreatitis by visible peristalsis early in the disease, progressive vomiting, a painless abdomen, the absence of epigastric tenderness which radiates to the left transversely, the absence of left lumbar tenderness, and the absence of the malar flush of acute pancreatitis.

Acute renal colic, particularly on the left side, is at times attended by extreme pain and shock. If there be absence of radiation down to the groin, acute hæmorrhagic pancreatitis must be borne in mind. This acute renal colic may be due either to a stone or to pus. Pyuria aids greatly in the differentiation. A sudden torsion of a ptotic kidney with strangulation of the renal pedicle may well simulate acute pancreatitis. Here the history of ptosis in a patient who has lost considerable weight, with a history of Dietl's crisis, and a sudden physical exertion, may be the exciting cause. The kidney is readily palpated and is found enlarged and tender, if it be found in the lumbar region, or it may have been displaced to the mid-abdomen, but it will be found movable and may be reposited in the lumbar fossa.

Tenderness in the left inguinal region, a definite head zone, is not at all

infrequent in acute hæmorrhagic pancreatitis, particularly if considerable hæmorrhagic fluid be present in the peritoneal cavity.

Acute hematogenous infection or carbuncles of the kidney at times calls for differentiation. Here the antecedent history of some focal lesion, such as a furuncle, carbuncle, paronychia, or some upper respiratory infection, etc., with sudden onset in an otherwise healthy individual, of a chill, rise in temperature, tenderness in either lumbar region with lumbar spasticity with or without any urinary symptoms or findings, such as blood or pus, particularly if the anterior surface of the kidney be the site of adhesions to the parietal peritoneum, may be confused with acute hæmorrhagic pancreatitis. The toxæmia, the shock, the flush paretic abdomen and the characteristic epigastric tenderness with radiation to the left of acute pancreatitis are absent.

Perforated gastric or duodenal ulcer with their antecedent ulcer history, their board-like rigidity, and scaphoid appearance of the abdomen, may well be distinguished from the paretic abdomen, the absence of resistance felt in the mid-epigastrium with radiation to the left. The early signs of spreading general peritonitis, the presence of gas in the peritoneal cavity, elicited by the absence of liver dulness, the absence of malar flush, the expiratory grunt, exclude the probability of acute hæmorrhagic pancreatitis. Then, again, the ulcer patient depicts a countenance characteristic of stomach pathology. The long, thin, drawn, dyspeptic portraying chronic pain is a facies easily recognizable.

Cardiac and coronary disease require consideration. Careful cardiac examination is absolutely essential before any operative intervention is instituted, for the protean manifestations of cardiac disease may simulate many intra-abdominal catastrophes. Preëxisting cardiac history with tender liver due to right coronary closure, marked rigidity of the upper abdomen with extreme hypersensitiveness of the abdominal wall, frequently leads to correct diagnostication. Electrocardiograms are important adjuvants.

Perhaps too often do we err, but rather on the side of making the diagnosis of acute pancreatitis when such does not exist, but the knowledge that such an entity exists often leads to the correct diagnosis.

Complete exploration in many instances is interdicted because of the extreme gravity of the patient's condition, but knowledge of our findings, in so far as feasible, are here added, the better to understand the disease.

Fat necrosis, as mentioned above, has been taken as the criterion of diagnosis. This finding is, therefore, universal in our series.

Biliary disease was a concomitant finding in 84 per cent. Calculi were found in fifty-four cases of those presenting gall-bladder pathology. In two cases cholecystectomy had been previously performed. In thirteen no mention of gall-bladder exploration was made. Severe acute biliary disease was never encountered.

Pancreatic inflammation of varying degrees was found. Œdema and enlargement in forty-nine. Hæmorrhage, in addition to œdema and enlarge-

ment, in twenty-three. A congested gland was observed in seven cases, six fifty-two cases.

The peritoneum presented the congestive variety of inflammation. Fat necrosis was found throughout this structure. The omental and pancreatic peritoneum were most frequently involved. Beef broth fluid, that serosanguineous exudate resulting from peritoneal irritation, was present in were necrotic, and in three abscesses were present.

Interesting is the observation that the omentum in acute pancreatitis assumes a peculiar grayish-yellow, and may feel gritty. This finding, pointed out in 1915,[2] leads to the exploration of the pancreas, thereby disclosing pathology otherwise unsuspected. This characteristic granular omentum was encountered in 43 per cent. of our cases. At times, this apron-like structure assumes such size as to allow of palpation before celiotomy.

Operative Findings in Acute Pancreatitis

Observation	Incidence	Per cent.
Fat necrosis	88	100
Gall-bladder disease	74	84
Biliary calculi	54	61
Beef broth fluid	52	59
Granular omentum	38	43

Pancreatic Findings

Œdema and enlargement	49
Œdema, enlargement and hæmorrhage	23
Œdema, enlargement and congestion	7
Necrosis	6
Abscess	3
Tail involved	2

The immediate treatment resolves itself into saving life. Relieve the pressure on the semilunar ganglion and common duct by opening the pancreatic capsule. If the patient's condition warrants, the operation of choice, cholecystectomy, removes the source of infection. At times drainage of the gall-bladder must suffice to drain the pancreas.

Operative Procedure

Procedure	Cases	Deaths	Mortality Per cent.
Cholecystectomy with drainage	20	2	10
Cholecystostomy with drainage	40	7	17.5
Choledochostomy with drainage	2	0	0
Choledochostomy with cholecystectomy	3	0	0
Pancreatic drainage	23	14	60
General average	88	23	26

Twenty-three of our patients succumbed. Our rather high mortality rate of 26 per cent. compares favorably with all others. We must recall, however, that operation is being performed in a very serious complication of disease which if treated early is more amenable to recovery. Proper early treatment of biliary disease will decrease the mortality rate of acute pancreatitis. The time to intervene is when the disease is still limited to the gall-bladder.

SUMMARY

1. The etiology of acute pancreatitis is discussed pro and con. Emphasis of gall-bladder disease as precursor cited.
2. Eighty-eight cases analyzed with especial reference to symptomatology.
3. Differential diagnosis stressed.
4. Operative findings recorded, operative procedures with results obtained.
5. Acute pancreatitis can be diagnosed pre-operatively if the existence of such an entity be borne in mind.
6. Early treatment of gall-bladder disease encouraged.

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REVIEW OF THE OPERATIONS DONE ON THE GALL-BLADDER AND DUCTS*

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Nearly every operation which has been introduced has been subjected to a certain amount of abuse, which has usually taken the form of employing it in the absence of indications or even in the presence of contraindications. It would appear that time alone can determine the actual value of a surgical procedure. Many operations have failed to stand the test of time and have been relegated to oblivion; others have become fixtures although their fields of application may be far more limited than early enthusiasts thought possible. A glance over the history of surgery gives innumerable illustrations of these statements. One has but to recall the operation of ovariotomy and its world-wide abuse; that of removal of the coccyx to cure all manner of ills; those done for visceral ptoses; colectomy for constipation, not to mention its claimed benefits in thyroid disease, cystic disease of the breast and insanity; and the employment of gastro-enterostomy for the cure of epilepsy. These are only a few examples that come readily to mind, but they are sufficient to show that it is well to cast a philosophic eye over our work from time to time and not be carried away by enthusiasm for any one procedure.

The operations above mentioned have and probably always will have a definite place in surgery, but no surgeon today thinks of giving them the wide and wholesale application they once had. One reason for the foolish and unwarranted employment of operations has been the fact that he who questions a popular dogma or fad lays himself open to the criticism of being a conservative or behind the times, and most men of judgment have been content to stand aside and silent until time has done its work. The best illustration one could find of this truth is the history of resection of the colon.

The foregoing remarks are made as an apology for what is to follow in a consideration of the different operations done on the bile passages and in an attempt to estimate their relative values. The determination to discuss this subject is largely due to a prevalent idea among some surgeons and internists that the removal of the gall-bladder is a cure-all for all the diseases and infections of the biliary passages, and yet this is no more true than the claims made for some of the operations already mentioned, no more true than the belief that colectomy cures hyperthyroidism and insanity. The one point that needs constant reiteration and emphasis in surgery of the bile passages is not the particular type of operation, but to be sure of the condition of the common duct and liver, and that in the case of stones none are overlooked.

*Read before the Philadelphia Academy of Surgery, April 1, 1929.

Cholecystostomy was the first operation done for gall-stones and empyema, and although performed several times in the seventeenth century, it was not generally practiced until the late eighties of the last century. Petit in 1743 did this operation for the first time with the deliberate purpose of removing stones. The previous operations were rare and most of them may be classed as accidental performances. Notwithstanding Petit's publication nothing much was done in gall-bladder surgery until the latter half of the last century, and at this time, a number of American surgeons began to publish their operations.

Bobbs in 1867 performed the first cholecystostomy in one stage; previous to this adhesion of the gall-bladder to the abdominal wall was awaited or effected before the gall-bladder was opened. Ignorant of Bobbs's operation, a number of surgeons in different parts of the world in the next ten years performed cholecystostomy. Both Keen and Marion Sims, cognizant of Bobbs's publication, reported similar operations in 1877. In most of the early operations the manipulations were confined to the gall-bladder itself. In the early eighties, operations on the gall-bladder had become pretty well established, largely due to the work and publications of Langenbuch. Within the next ten years cholescystostomy was gradually recognized as the proper operation for gall-stones and infections of the gall-bladder.

In recent years so little has been said of it and so much of other operations that one might suppose that in the modern clinic it was no longer employed. Notwithstanding the development of other and better operations for most of the cases, this operation still has its place and its definite indications, and is often a life-saving procedure when the other operations would carry with them too great a risk. Any surgeon of long experience can recall scores of patients very ill from empyema of the gall-bladder permanently cured by simple incision, removal of stones and drainage and who certainly would not have withstood the more formidable procedure. In such cases this operation is easily carried out with infiltration anæsthesia. If the stones are all removed it is remarkable how few of these patients have any further trouble. It is true that a very small percentage may have strictures with persistent mucous fistulas requiring subsequent cholecystectomy. The recurrence of stones is one of the arguments strongly put forward against this comparatively simple operation, but I should like to say that in my own experience the re-development of stones has been most unusual, and that if a stone is found at a second operation, it was probably overlooked at the first operation. I see recurrences after my operations for hernia and for duodenal and gastric ulcer, but recurrence of gall-stones is a rarity. I recall one case of definite recurrence of stones. The patient was a physician from whose gall-bladder, many years ago, I removed a number of stones. He came back in about a year suffering as before, and I was sure I had overlooked a stone; but at the second operation, I found not one but twenty-five light-colored stones all of the same size. This case stands out in my memory as a unique experience. All surgeons will agree that most stones found at a second operation represent "left overs" in the cystic or common duct and it would seem pertinent to observe in this

connection, that if stones are overlooked, the patient is better off with than without a gall-bladder.

The experience and ability of the operator should always be taken into account when the choice of operation is being considered, and where these are lacking, cholecystostomy should be done, especially when the patient is a poor risk and access to the structures difficult. Nothing seems to me more absurd than the statement that cholecystostomy carries with it as high a mortality as cholecystectomy. Such an opinion is based on the statistics of large clinics and of experienced surgeons without regard to the fact that the extremely ill patients, and those who are bad risks, are the ones usually subjected to cholecystostomy. In many of the cases of stones or sand in the common duct, especially if complicated by jaundice, I believe it is wise to preserve the gall-bladder, for it is these cases that are apt to have further trouble, and in such circumstances they are better off with a gall-bladder. In the aged also cholecystostomy is often better than cholecystectomy.

Cholecystectomy is not a new operation, having been first and successfully done by Langenbuch in 1882. It is today the most commonly performed operation for stones and infections of the biliary passages and may be looked upon as the ideal operation in most cases, but it is not in any sense a cure-all nor is it indicated in all cases. Before discussing this operation, when I will refer to certain objections to it, I should like to say that in my last three hundred operations on the gall-bladder and ducts, the gall-bladder has been removed in about 70 per cent. This will show that I give it a wide field of application.

First of all let us consider the physiological effect of the removal of the gall-bladder. It has been shown by experimentation on animals and confirmed by observations at later operations on patients, that an inevitable result of cholecystectomy is a dilatation of the common duct, of the hepatic ducts and of all their radicals. Whether this is particularly harmful I doubt, but it represents a disturbance of the whole biliary circulation. One is only justified in bringing about this anatomical change, with its physiological disturbance, by definite disease of the gall-bladder. This statement is made with the thought in mind that many normal gall-bladders are being removed and many others which only represent a participation in a general biliary infection, which is but little helped by cholecystectomy. Another aspect of this operation that needs consideration is the danger in its performance of injury to the common duct. The importance of avoidance of such injury has been repeatedly stated and yet the evidence of it is multiplying in every surgical clinic in the shape of strictures of the common duct following cholecystectomy "done elsewhere."

I would not say that all these strictures are the result of injury of the duct at the first operation, but I believe nearly all of them are. The harm is done by the careless use of forceps supposedly applied only to the cystic duct and to control bleeding from the cystic artery. The injury is not recognized until later when a persistently increasing jaundice is observed. In the last issue of *Surgery, Gynecology and Obstetrics* (March 27) Walters, of the Mayo

Clinic, reported seventeen cases of stricture of the common duct; in thirteen a cholecystectomy had been done "elsewhere" and in three a cholecystostomy had been done. Stricture of the common duct does undoubtedly occur from causes other than traumatism, but it is significant that the large majority follow cholecystectomy. Other reports and experience confirm the above figures.

Another statement which I am sure is incorrect and yet one hears it frequently, is that fewer and less crippling adhesions follow cholecystectomy than cholecystostomy. Has anyone ever seen any more dense and extensive adhesions than at a second operation after the removal of the gall-bladder? This is not put forward as an argument against cholecystectomy, but only an attempt to look facts in the face and oppose spurious contention. The adhesions after removal of the gall-bladder are said to be due to the introduction of a drain, and attempts have been made to do away with it. In many cases the drain is not necessary, but the difficulty is to know which they are. It is a common observation that in a small percentage of cases after cholecystectomy, leakage of bile occurs. If there is no loosening of the ligature on the cystic duct, this drainage probably comes from open radicals in the gall-bladder bed and no amount of careful suturing will always prevent it. Having lost one case from infection following bile leakage, I long ago abandoned closure without a soft rubber drain.

In a number of cases the removal of the gall-bladder becomes a very difficult procedure and its accomplishment may so add to the risk as to offset its advantages. In many of these cases where I have been most anxious to remove it I have resorted to subperitoneal excision, an operation well described by C. L. Gibson, and similar to the "rat-tail" operation sometimes employed in removing a very adherent appendix. (ANNALS OF SURGERY, vol. lxxxiii, p. 613, 1926.) I have already referred to the importance of removing all stones, but I cannot leave the operation of cholecystectomy without saying that it should never be done without absolute knowledge that the common duct is free of stones and obstruction. A dilated common duct in the presence of a functioning gall-bladder means obstruction and it should be opened.

In regard to the removal of stones from the common duct, I have but one thing to say; if one has a troublesome stone in the ampulla or in the duodenal portion of the duct, it is often better and more safely removed through an incision in the duodenum than by forceps passed into the duct. Much damage can be done to an inflamed or even to a normal duct by rough instrumentation, with great likelihood of subsequent stricture. The forcible passage of a probe or forceps through the duct to make sure of its patency is equally fraught with danger. Avoidance of traumatism to this delicate and essential passage should always be kept in mind in operations involving it.

Anastomoses of the gall-bladder or common duct with the stomach or duodenum, although not new operations, having been first successfully done in the early eighties, have been recently perfected and constitute well-recognized surgical procedures of value in cases of insurmountable obstruction of the common duct. For a time it seemed that these operations offered "a way

out" of many troublesome situations, and being so often successfully accomplished, their field of application was gradually enlarged, including even the treatment of duodenal and gastric ulcer. I confess that I had begun to feel that this method of internal drainage was the answer to many of our gall-bladder, common duct, and liver problems. In our zeal for improving and simplifying the technic we rather put aside any question of possible danger from an ascending infection. The operations became much easier by the use of catheters or small rubber tubing as a splint and as a means of insuring adequate drainage, although some surgeons insisted that a large stoma with direct approximation of the mucous membrane was the better procedure. The tolerance of the tubes had already been shown by Pierre Duval, who often passed them through the common duct into the duodenum and sutured them into position, and I think no subsequent experience has shown that the tubes cause any trouble *per se*, in spite of the fact that many of them have been shown in place by the X-rays years after the operation. Technically these operations would seem to offer all that could be desired, and yet I believe the future will show that their performance is only justified by an obstruction of the common duct which cannot be overcome.

If infection can ascend from the duodenum through the normal common duct then how much more easily can it take place with a permanently open communication? Experimentation on animals, X-ray studies and occasional clinical observations have, I think, clearly established the fact that these permanent artificial communications between the bile passages and the stomach or duodenum are apt to be followed by a more or less serious ascending infection. Beaver, of Rochester, Minn. (*Archives of Surgery*, vol. xviii, No. 3), found that after a series of cholecystogastrostomies on dogs, infection of the biliary passages and liver invariably occurred. The röntgenologists have also shown that at least in some of these cases barium will ascend into the biliary tracts. The clinical evidence of infection after these operations I am afraid we have too often attributed to a failure of the stoma to perform its function. Where a tube has been used and is still *in situ* such reasoning is certainly fallacious. Walters's cases present an interesting study in this connection. Although the large majority show an excellent result, in spite of the fact that many were distinctly bad risks, at least seven of the fourteen who survived the operation showed subsequent symptoms of infection which fortunately seem to have subsided in most of them. The most striking example is reported as follows: "In one case in which there was a very large anastomatic opening between the duct and the duodenum, severe cholangitis developed two or three months following the operation in the absence of extrahepatic biliary obstruction. It was accompanied by progressive enlargement of the liver and spleen and the formation of ascites. With the subsidence of the intrahepatic infection, jaundice and fever disappeared but the enlargement of the liver and spleen still persisted. The ascites, however, disappeared after the administration of a mercurial diuretic."

In February, 1925, I did a choledochoduodenostomy on a patient who had been operated upon "elsewhere" in January, 1924, the gall-bladder being removed for stones. At the first operation, troublesome bleeding from the cystic artery occurred which was controlled by forceps which were left in the wound. On removal of the forceps, drainage of bile began and kept up for some time. Six months later a gradually deepening and painless jaundice developed. When I saw the patient, a number of months later, his color was that of dark mahogany. When I exposed the common duct it was greatly distended and colorless; on opening it there escaped under great pressure a quantity of white bile. An anastomosis was made with a catheter, the large end in the duodenum. There was no stone in the ducts and the patient had never had any symptoms before or after his first operation of common-duct stone. The obstruction was due to cicatricial tissue. The jaundice gradually disappeared and the patient returned to his work. For the next three years this man had repeated attacks consisting of pain, chills, fever and jaundice all of short duration. As the tube did not show in the X-ray plates made three months after operation, I thought perhaps the stoma had contracted. As his attacks became of shorter duration and the intervals between them longer, such a theory was hardly tenable. The patient is now apparently quite well.

It seems likely that infection alone can explain this post-operative course. This evidence is not presented with the idea of disparaging anastomosis between the bile passages and the gastro-intestinal tract, but to show that operations should only be done where there is an irremovable obstruction to the normal channel. In concluding this discursive and critical review I would offer the following propositions:

1. Cholecystostomy still has a distinct field in gall-bladder surgery.

2. Cholecystectomy approaches the ideal operation, but is not applicable to all cases. The only warrant for this operation is definite pathology. The normal gall-bladder should not be removed.

3. The anastomoses are only justifiable in the presence of an irremovable obstruction of the common duct.

4. More important than the choice of operation is the removal of all stones and the assurance that the common duct is patulous.

5. Drainage is still essential in these operations.

SURGICAL CONDITIONS OF THE BILIARY TRACT *

By Frank H. Lahey, M.D.
of Boston, Mass.

In any discussion of the gall-bladder and bile ducts, it is of interest to inquire as to what are the functions of the structures concerning which we are to talk. This question can readily be answered as far as the common and hepatic ducts go, serving as they do as the canal along which bile is conveyed to the duodenum, equipped as the canal is with a sphincter of Oddi and also with the duct obliquely entering through the duodenal wall, so that a competent valve is formed. We know that bile descends along the ducts by secretory pressure, that the ducts are not equipped with sufficient musculature for any marked contraction, and that even though the gall-bladder be removed, although the common and hepatic ducts dilate, still bile is satisfactorily delivered into the duodenum, and duodenal contents do not ascend the ducts to produce infection in the liver.

When we come to discuss the function of the gall-bladder, however, things are not as plain. We know that the gall-bladder is equipped with muscle fibres; we know that the gall-bladder does contract, particularly with a fat meal, and yet is never found empty; we know that this contraction can be brought about by a hormone as proven by the crossed circulation experiments of Ivy and Oldberg, of Northeastern University. What the purpose of this organ is, however, without which humans and animals survive so well, is by no means clear. Various theories have been advanced as to the function of the gall-bladder, such as concentration of bile, and there seems no question but that this is its most important function; such as equalization of biliary pressure and even bile storage, but it must be admitted that whatever the function of this small sac is, it does not appear to be one which plays any essentially important part in the body. Until physiologists can advance our knowledge of the purpose of this structure, we must admit its similarity to the vermiform appendix, except for the vestigial origin of the former, and accept the fact that like the appendix it does not appear to serve any indispensable purpose, but frequently does serve many undesirable ones.

If one be permitted to throw out those uncommon cases of carcinoma of the gall-bladder and traumatic rupture of the gall-bladder, then we can limit for practical purposes the causes of the pathological states of the gall-bladder with which we have to deal to those of infection and those of calculi, both of which conditions, while often separate in the beginning, almost always eventually become coincidentally present.

* The Stewart Memorial Address, read before the Pittsburgh Academy of Medicine, November 30, 1928.

We are not with certainty aware as to just how infection reaches the gall-bladder. We cannot with certainty say that the infection spreads from the liver to the gall-bladder, as has been stated by Graham, in the form of a hepatitis, although today this is the most tenable theory; or whether it reaches the gall-bladder by ascension, or by the blood stream. For the present, we can only note the frequency with which infection occurs in the gall-bladder, the destructive effects of infection upon the gall-bladder both as to its ability to contract and upon its ability to concentrate bile. We cannot fail, also, to be impressed with the frequency with which gall-stones are associated with infection in the gall-bladder, and with the probability that this infection plays a very considerable part in the production of gall-stones.

FIGS. 2C and 2D.—Microphotographs showing single cholesterol laden polyp-like projections of gall-bladder mucosa. The cholesterol stains black. These are microphotographs of one of the white specks in the so-called strawberry gall-bladder.

That gall-stones exist not infrequently without infection we all know, as has been stressed by Aschoff in his discussion of the cholesterol gall-stone. Everyone who is dealing with gall-bladders surgically has repeatedly observed those pure cholesterol stones of canary yellow or pale whitish color with crystalline centres in gall-bladders which show no evidences of infection. (Fig. 1.) It seems probable, therefore, from the frequent occurrence of cholesterol gall-stones and the cholesterol gall-bladder that some change or error in the cholesterol metabolism plays a very considerable part in the production of gall-stones.

As the result of our own practical experience with biliary tract diseases, it is at least possible to construct in our minds a very reasonable sequence of conditions in the development of gall-stones, each one of these conditions representing states of the gall-bladder which we have seen in various individuals at the time of operation. We know, for instance, from an experimental point of view, that Dewey has been able to produce gall-stones in rabbits by feeding cholesterol until a hypercholesterolemia was produced. We know also that there is an increase in the blood cholesterol in pregnancy and in diabetes, both conditions with which we have clinically associated a

FIG. 1.—The single, canary yellow, pure cholesterol stone and a cholesterol gall-bladder.

FIG. 2A.—The early cholesterol (strawberry) gall-bladder. The fine white specks represent cholesterol deposits in the mucosal projections lining the gall-bladder and are shown in the microphotographs. Figs. 2C and 2D.

FIG. 2B.—The cholesterol gall-bladder which has progressed to the stage of multiple small cholesterol stones. Note the white cholesterol plaques still in the mucosa lining the gall-bladder.

FIG. 3A.—The early calcium bilirubin stone. Note the absence of cholesterol and the thick-walled gall-bladder.

FIG. 3B.—Late calcium bilirubin stones. Note the thick-walled gall-bladder, the absence of cholesterol deposit on the pale, smooth mucosa; the result of long-standing infection.

definite gall-stone incidence—in the former much more than in the latter. We further know that there is a hypercholesterolemia in jaundice. We all associate gall-stone incidence with adiposity, and we are all aware of the increase in blood cholesterol with weight reduction procedures.

A careful inspection of gall-bladders removed at operation with the question of the development of cholesterol stones in mind permits one to observe such evidences of various cholesterol changes in the gall-bladder wall and within the gall-bladder itself that it is possible to construct a mental picture of the development, at least, of a cholesterol gall-stone, from the point of deposit of cholesterol crystals beneath the lining mucosa of the gall-bladder up to the point of the development of fine grains of cholesterol in the form of sand (Fig. 2A) and from these to the development of considerable sized multiple or single cholesterol stones (Fig. 2B), examples of which will be shown on the screen.

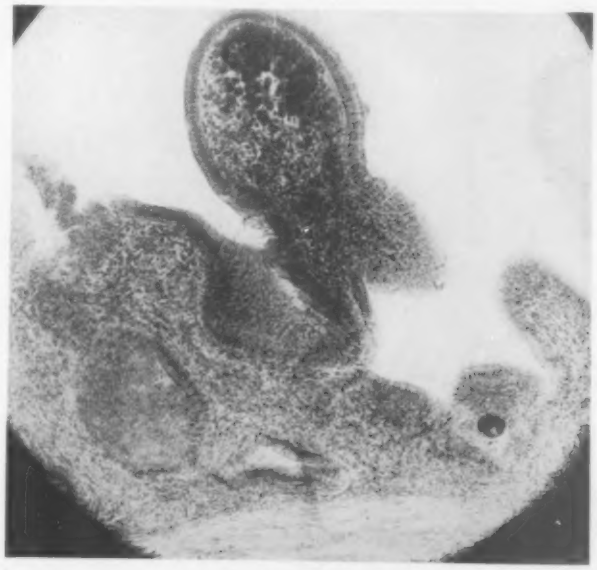

FIG. 2D.

We now know from the work of Boyd that the so-called strawberry gall-bladder, which upon removal is found to show numerous small white specks upon its mucous-lined wall, similar to the small white dots upon the covering of a strawberry, is the true early cholesterol gall-bladder, and that the white specks are lipoid deposits of cholesterol beneath the polypoid mucosa of the gall-bladder. We know also of the tendency of these cholesterol-laden polypoid masses to break off at their base (Figs. 2A–D), and one does not have to stretch the imagination unduly to assume that such crystal-laden masses may well serve as the nuclei of stones when floating free in bile rich in cholesterol crystals.

While pure cholesterol stones occur without associated infection, it is probably true that infection frequently soon appears as the result of the presence of these foreign bodies, particularly if one of the stones becomes lodged in the cystic duct and produces stasis as the result of an obstruction to the outflow of bile.

That infection of the gall-bladder is common is proven by the fact that Mentzer at The Mayo Clinic found in six hundred and twelve autopsies, that the gall-bladder showed cholecystitis in 66 per cent. of the cases. As has already been stated, the association of gall-stones and infection is con-

sistently striking, and while the early stones unassociated with infection are no doubt due to some error in cholesterol metabolism, those stones of calcium bilirubin origin are in all probability the result of, and always associated with, infection of the gall-bladder. (Figs. 3A–B.) A further discussion of the arguments as to how infection reaches the gall-bladder and as to whether or not bile both enters and leaves the gall-bladder by the cystic duct (Sweet believing that bile enters but does not leave the gall-bladder by

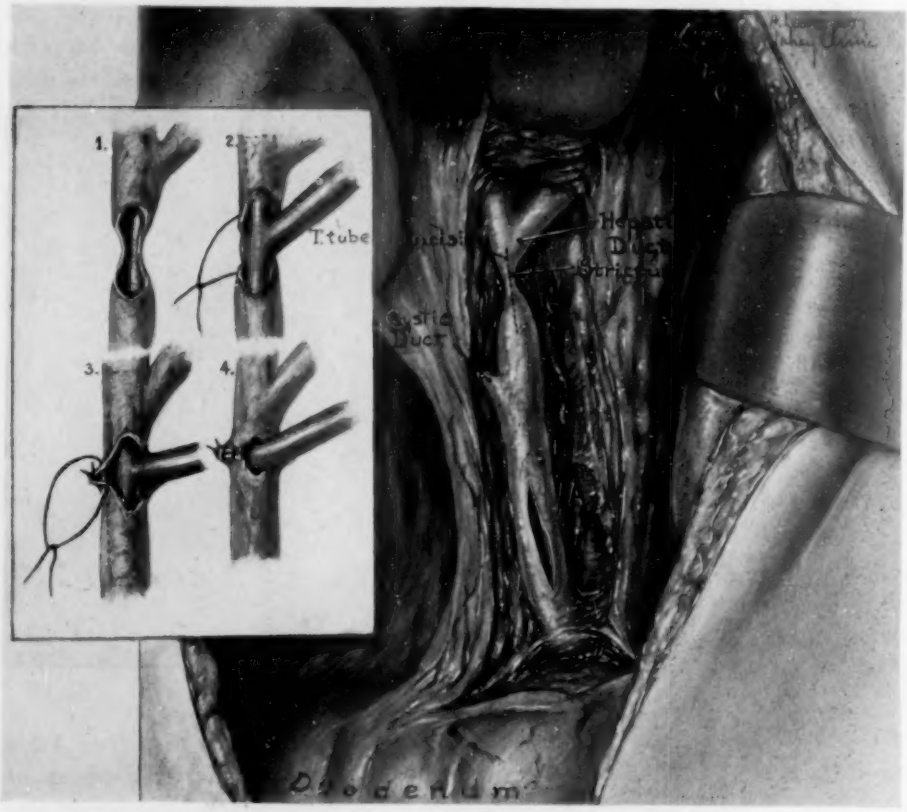

FIG. 4.—Showing an incomplete stricture of the hepatic duct, probably due to indiscriminate clamping in cystic artery bleeding. Note the two methods we have employed for identifying the main bile duct, one, by demonstrating the division of the hepatic duct and two, by increasing the parietal peritoneum beside the duodenum, rotating that inward, and demonstrating the retroduodenal duct. The common duct is open for retrograde probing to demonstrate the stricture. The insert, 1–4, shows the method of suturing the longitudinally incised stricture about a T tube.

the cystic duct), as to the mechanics of how the gall-bladder empties itself, as to the presence and function of the sphincter of Oddi, as to what causes bile to enter the duodenum by spurts, and as to the ability of the gall-bladder to concentrate and store bile, would convert this lecture into an academic one rather than a clinical one, as is my purpose, dealing with our clinical experiences with biliary tract disease.

For practical purposes we may assume that the above-stated points have been fairly well proven, as follows: Bile does enter and leave the gall-bladder by the cystic duct. The gall-bladder probably empties itself by the sum total

of several factors: its elastic recoil, its muscular walls, abdominal pressure, and relaxation of the sphincter of Oddi. There is little question now of the ability of the gall-bladder to concentrate bile, and the spurts of bile into the intestinal canal are in all probability due to the change in tonus and intraduodenal pressure within the lumen of the intestine.

Let us now consider the practical aspects particularly of gall-bladder disease. First, cholecystitis. Clinically, we are today considerably handicapped in dealing with cholecystitis, due to the fact that while we have made marked advances in the chemical and röntgenological studies of the diseases of the gall-bladder, the reports from the pathologist's laboratory regarding this condition still fall far short of the clinician's desire. There is no lack of agreement either clinically or pathologically as to the diagnosis of acute cholecystitis, and there is no reason for me to discuss the subject of acute cholecystitis.

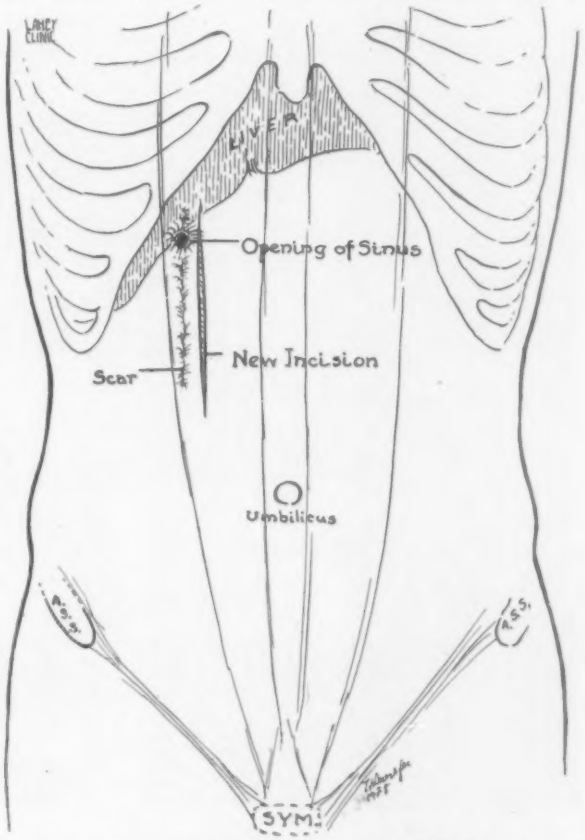

FIG. 5.—The permanent biliary fistula is shown in the upper end of the old scar and the new incision for coning and implanting of the fistula is shown just inside the previous one.

Chronic cholecystitis, however, is a very much different problem. By chronic cholecystitis we mean to indicate a non-acute lesion of a gall-bladder not containing stone and supposedly producing symptoms. This we feel strongly is today one of the most difficult and unsatisfactory of all the lesions of the gall-bladder with which to deal. It is difficult, first, because of the fact, as already suggested, that our pathologists, at any rate, almost never return us a pathological report of a normal gall-bladder, and no matter how normal the gall-bladder may appear, it seems to contain sufficient round-cell infiltration and other evidence so that the pathologist is usually led to report his findings as consistent with chronic cholecystitis.

The condition is further made difficult by the fact that chronic cholecystitis is not typified by any classical and definitely tangible chain of symptoms. It is additionally complicated in that a great many patients who are

operated upon for supposed chronic cholecystitis, and whose gall-bladders have been reported by the pathologists as chronic cholecystitis, still continue to suffer from the same chain of symptoms from which they suffered previous to the operation. Indeed, so uncertain are we today regarding the clinical and pathological diagnosis of many cases of chronic cholecystitis that we are almost entirely dependent for certainty of diagnosis upon the patient's interpretation, following surgery, as to relief or non-relief of her

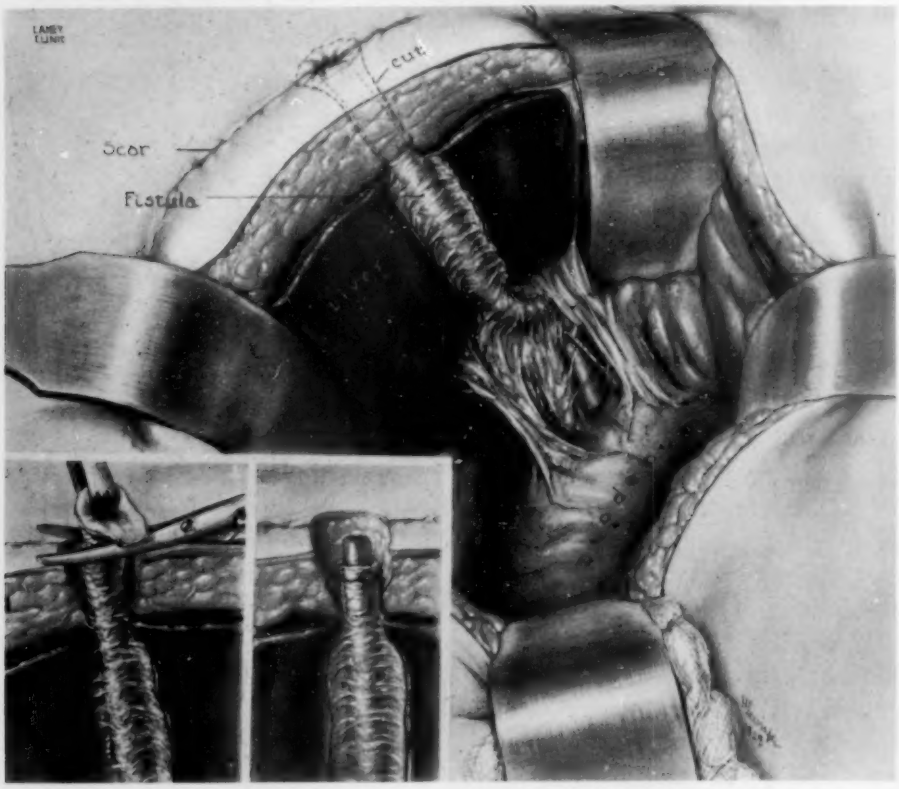

FIG. 6.—The fistulous tract is shown adherent to the bed of the liver. The insert shows the fistulous tract cored out of the abdominal wall, its button of fistulous skin cut away and a short segment of rubber catheter tied into the end of the fistulous canal. Note that the fistula is freed only down to the border of the liver. This point is stressed since the success of the procedure depends upon leaving the fistula adherent throughout its length to the liver bed. This insures good vascularization for the fistulous tract and but a short unvascularized segment, which is to be inserted into the jejunum, duodenum, or stomach.

symptoms. The more vague the symptoms from which the patient is supposedly relieved following cholecystectomy, the less valuable this criterion becomes.

In this condition of so-called chronic cholecystitis, it becomes not only necessary to employ every diagnostic measure in attempting to determine definitely the presence of this lesion, but it is necessary to eliminate insofar as is feasible the possibility of other factors entering into the production of symptoms suggesting the possibility of this lesion. The very vagueness of the symptoms of chronic cholecystitis of necessity often makes the diag-

nosis doubtful. Unless there is definite evidence of gall-bladder pathology by cholecystogram, such as failure to fill or distortion of outline, together

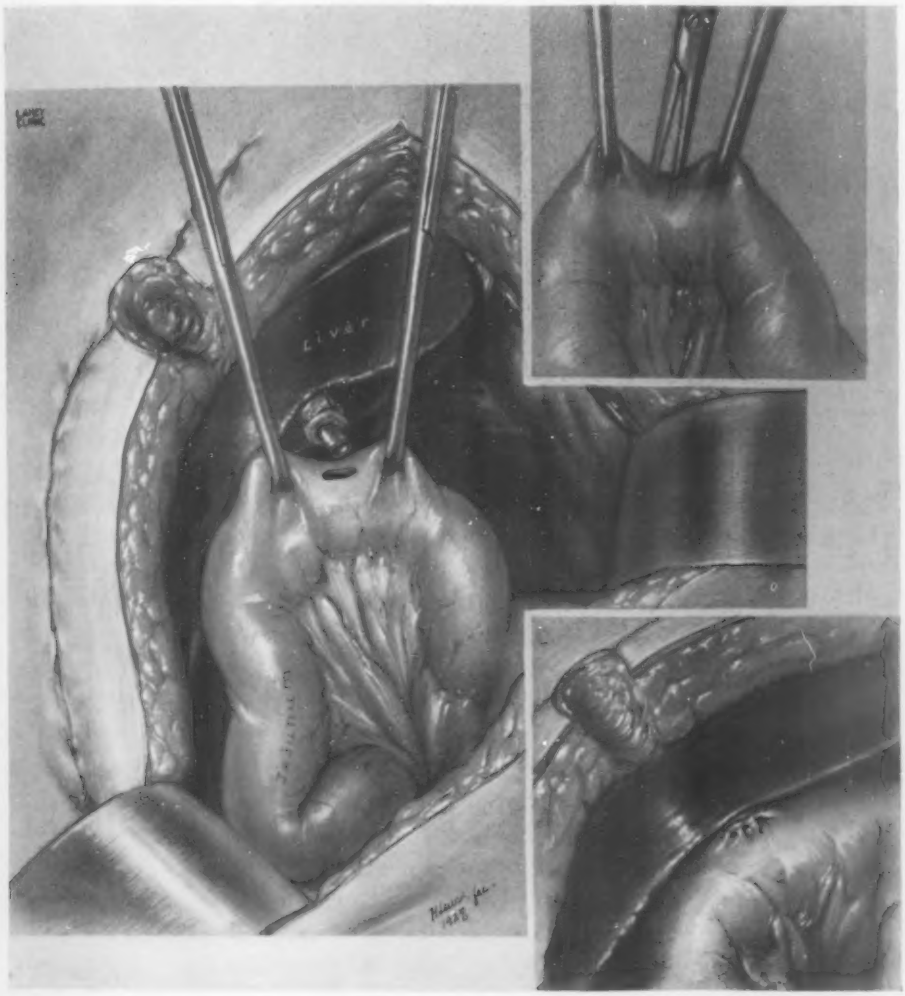

FIG. 7.—The fistulous tract prepared as described in Fig. 4. The anterior surface of the liver freed of any of its adhesions to the abdominal wall and parietal peritoneum. This permits the liver with its prepared fistulous tract to fall downward so that a segment of jejunum may be found which can easily be brought up to it. This segment is opened, as shown in the upper right insert, by forcing a sharp-pointed hemostat into the bowel grasped by two backing forceps. Such a procedure has the advantage of making but a small opening which can be dilated by gently spreading the jaws of the hemostats, thus avoiding cutting of muscle fibres, pouting of mucosa and permitting a very accurate fit to be made between the opening and the fistula. The lower right insert shows a purse-string suture in the jejunum about the implanted fistula. It does not show a stitch between liver capsule and the jejunum to hold the latter in close contact with the liver. Note that the purpose of the short segment of rubber tube to be passed later into the jejunum is to temporarily prevent the purse-string suture from occluding the implanted fistulous tract.

with clinical evidence of the disease, the wisdom of surgical intervention is doubtful.

Cholecystography has proven to be one of the greatest factors in advancing the diagnosis of gall-bladder lesions, but, as in other laboratory measures, is of value only when correlated with clinical findings.

We have felt justified in making a diagnosis of chronic cholecystitis and advising cholecystectomy in our clinic when the case could be said to meet the following requirements: In the presence of symptoms such as nausea, gaseous eructations, abdominal distention, and right upper abdominal pain, when adequate investigation failed to demonstrate other lesions which might be the cause of the symptoms, when the symptoms persisted in spite of medical measures, and when suspicious X-ray evidence by cholecystography was present. Under such conditions cholecystectomy has yielded satisfactory results. Cases operated without complying with these criteria will, we believe, yield a high percentage of unsatisfactory results.

There is one other condition in connection with chronic cholecystitis about which I wish to speak. That is, not removing a gall-bladder because of its normal external appearance, in a patient operated with the diagnosis of chronic cholecystitis based upon the criteria as already stated. We have assumed the position that no matter how normal the gall-bladder may appear at operation, if the patient's symptoms have been sufficiently distressing to make surgery worth considering, if they cannot be explained by other conditions after adequate investigation, if they are not relieved by medical measures, and if there is suspicious X-ray evidence by cholecystography, then, as already stated, no matter how normal appearing the gall-bladder may be, it should be removed. If under these conditions, because of the normal appearing gall-bladder, cholecystectomy is not done and then the symptoms persist, how may we say that the remaining gall-bladder is still not the cause of the symptoms? This advice is necessarily premised upon the conscientious adherence to the criteria as stated, and unless the fundamental factor, the presence of fair operative indications, is adhered to, the doctrine not only becomes valueless but dangerous. We must admit, I think, that the lack of gross pathological evidence with the gall-bladder in place, in chronic cholecystitis, fails to outweigh fair and critical clinical and laboratory findings.

The most interesting, the most tangible, and the most satisfactory of all of the biliary tract lesions is that of gall-stones. There are two preliminary statements concerning this condition which I would like to make. First, there are no harmless gall-stones; and second, an attempt should be made to diagnose and operate gall-stone patients earlier. While biliary colic may be the first symptom which causes the patient to present himself for advice, and may be the first impressive evidence to the patient that all is not well in his upper abdomen, nevertheless in many instances there have been abdominal and digestive symptoms occurring previous to the biliary colic, the investigation of which would often lead to the earlier diagnosis and removal of the gall-stones. We would urge also against permitting patients in whom there is no contraindication to surgery to go through repeated attacks of gall-stone colic before coming to surgery.

The sequelæ of long-standing gall-stones are numerous and undesirable. We know that long-standing gall-stones are quite constantly associated with long-standing gall-bladder infection. We know that the longer gall-stones

exist and the greater the number of attacks, the greater the incidence of common duct stones with their added operative risk. While we cannot say that it has been conclusively demonstrated that the lymphatics of the gall-bladder drain into the pancreas and so produce a pancreatitis of lymphogenic origin, nevertheless there are certain features in association between the pancreas and cholelithiasis that indicate that the latter has no good effect upon the former. While we cannot say that the hardened head of the pancreas which is so frequently seen with gall-stones is a pancreatitis as the result of the gall-bladder infection, and that a pancreatitis associated with gall-bladder disease causes diabetes (fortunately most of the islands of Langerhans are on the tail of the pancreas), nevertheless we can say that a patient who has diabetes and gall-stones can be made better by removal of his gall-stones and gall-bladder. In fact, Dr. E. P. Joslin has stated that if he could select his type of diabetes to have, he would choose a diabetes associated with gall-stones, since it would be capable of the greatest improvement through the removal of the gall-stones. We cannot also disassociate the frequency with which gall-stones are found in patients operated upon for acute pancreatitis.

So possible is it now, by means of cholecystography, for which we owe so much to Evarts Graham, to visualize early gall-stones by contrast shadows, and to demonstrate pathological gall-bladders, that we feel strongly that all vague, unexplained right upper abdominal complaints should be investigated for the possibility of early gall-stones. Patients who have had frank attacks of gall-bladder disease should be told of the disadvantages of delay in this condition and urged to early surgery, when the gall-bladder can be removed accurately, and when its bed can be so covered that there are few remaining adhesions between the duodenum, pylorus and gall-bladder bed interfering with the function of those structures.

The diagnosis of gall-stones at the stage of typical gall-stone colic requires no discussion. The less typical evidences of the condition are, however, not so easy to interpret. It has been our experience that the type of discomfort caused by gall-stones may vary from simple fulness after meals up to the typical colic of such severity as to demand morphia. The reference of pain in a typical way to the right shoulder-blade is by no means constant. We have seen pain referred in all directions and occasionally have observed the maximum pain to be localized in the left epigastrium.

In our experience, the point which we have found to be most suggestive of cholelithiasis in the patient's history is so-called residual tenderness over the gall-bladder region after the attack has passed, due, probably, to the abating infection in the gall-bladder wall.

When jaundice appears with typical gall-stone colic, it is strongly suggestive of the presence of stones, and of course strongly suggests the presence of stones within the hepatic or common duct. When jaundice is again and again associated with repeated gall-stone colic, one may be quite sure of the presence of hepatic or common-duct stones.

The fact, however, that jaundice does not occur in association with gall-

stone colic by no means indicates that common-duct stones are not present. We have in our clinic up to now operated upon 908 patients for biliary tract disease, and of these, 179 operations were on the common or hepatic ducts, either in addition to the gall-bladder operation or on the bile ducts alone—an incidence of main bile duct difficulties (demanding exploration in this series) of 20 per cent., one in five.

As the result of our experience with surgery of the bile tract, we have had the following conclusions impressed upon us: (1) That common-duct stones frequently exist in the absence of any symptoms; (2) that gall-bladder colic may occur with jaundice and symptoms strongly suggesting the presence of common-duct stone and yet none be found; (3) that infection in the common and hepatic ducts may occur unassociated with gall-stones and may produce symptoms and signs similar to those of common and hepatic-duct stones.

Up to January 1, 1926, there were done in the clinic 619 operations upon the biliary tract, of which ninety-six were explorations of the common or hepatic ducts, a percentage of 15.5 per cent. choledochostomies. From 1926 to 1927, 198 biliary tract operations were done, of which fifty were or included explorations of the common or hepatic ducts, a percentage of 30.3 per cent. choledochostomies. Up to the year 1926, our 15.5 per cent. explorations of the common or hepatic ducts yielded a discovery of duct stones in 8.4 per cent. of the cases. Between 1926 and 1927 our 30.3 per cent. explorations of the common and hepatic ducts yielded a discovery of common or hepatic-duct stones of 12.6 per cent. In other words, since 1926 we have doubled the per cent. of cases in which we have explored the ducts with the result that we have increased the per cent. of common or hepatic duct stones discovered by 50 per cent., and during this time our mortality has diminished rather than increased; up to 1926, 5 per cent., from then on, 1 per cent.

We feel sure from our experience that we have in the past overlooked many common or hepatic-duct stones, and that we must guard against a tendency to be satisfied solely with the removal of the gall-bladder and its contained stones in many cases of gall-stone colic.

Since we have a great many times removed common-duct stones from patients having no symptoms suggesting their presence, we feel sure, from our experience, that no matter how lacking the case may be in the way of symptoms or visual evidence, such as a thickened gall-bladder or dilated common ducts, of the presence of stones in the main bile channels, a most painstaking search and, if necessary, exploration of the ducts must be carried out as to their possible existence. This does not mean that the common duct must be opened in every case. It does mean that most careful visualization of the ducts must be made to demonstrate their size and thickness; that most careful palpation of the lower end of the duct must be carried out, since it is at this point where the duct is so often surrounded by the head of the pancreas that stones are so easily overlooked. In this connection, we have often been aided by incising the parietal peritoneum beside the duodenum

and rotating that structure inward so that the considerable portion of the common duct which is behind the duodenum is exposed, making easier, thus, the approach to the lower end of the common duct.

In our experience with biliary tract surgery, we have had occasion to deal with eleven strictures of the hepatic or common duct. Strictures of the common duct, other than the complete absence of the ducts or part of the ducts occurring in the new-born, occur at three points: in the hepatic duct just above where the cystic duct enters the common; in the main duct at the part where the cystic duct joins the common duct, and at the point where the common duct enters the duodenum.

A majority of the cases of stricture of the main bile ducts with which we have had to deal has followed previous gall-bladder operations, and investigation of the description of the previous operations in most of the cases has brought out the fact that a technical difficulty arose during the operation, consisting of hæmorrhage from the cystic artery and difficulty in controlling it, or difficulty in clamping the cystic duct.

Of these eleven cases, one was a stricture of the common duct at its point of entrance into the duodenum; four have been of the common duct at the point where the cystic duct enters the common duct; three were in the hepatic duct at the point where the cystic artery is in relation with it; two were cases in which the common and part of the hepatic duct were completely destroyed, and in one there was complete obliteration of the main bile channel from the duodenum well up into the substance of the liver. Two of the strictures followed operations done in the clinic and nine followed operations done elsewhere.

The diagnosis of injury or severance of the common or hepatic ducts is not difficult when following an operative procedure on the gall-bladder or ducts in a patient whose bile has previous to operation entered the intestine; there is an immediate and persistent discharge of bile through the wound, with persistently clay-colored stools, and in a patient in whom there is no question of carcinoma.

The diagnosis of stricture of the common duct due to an injury and incomplete narrowing of the ducts is not as simple as when the duct is completely severed and there is a complete and persistent discharge of bile through the abdominal wall. Strictures of the ducts are for the most part the result of a clamp or a tie being placed upon the wall of the duct, causing injury to the wall of the duct and later contraction of the scar. (Figs. 3 and 4.) In our stricture cases jaundice did not develop for several months following the previous operation, and when it did appear was not associated with any severe degree of pain. One should, therefore, be suspicious of the presence of a stricture of the common or hepatic duct when relatively painless jaundice appears a few months after a gall-bladder operation, particularly if the operation has been associated with technical difficulties during its performance. Repeated attacks of painless jaundice with the above history quite definitely suggest the possibility of the common or hepatic duct.

We have been much interested in operating upon these strictures of the common and hepatic ducts to observe to what degree the ducts could be narrowed and yet exist so for months without jaundice. In many instances the opening through the strictured duct was so small that it would hardly admit the point of the smallest probe, yet jaundice in these cases doubtless had not occurred until infection, swelling, and the accumulation of mucus had brought about a blocking of the already narrowed duct. It is evident, then, that sufficient bile can pass through ducts which have been very much narrowed without causing back pressure enough to produce jaundice, provided there is no infection present.

There is a variety of methods of repairing strictured ducts, but most of them are far from satisfactory in that the stricture tends to recur with subsequent attacks of jaundice when infection is again superimposed.

We have repaired all of our strictured ducts of this type by the method illustrated in inserts 1-4 (Figs. 3 and 4), consisting of suture of the duct about a short T-tube after longitudinally increasing the duct at the point of stricture.

The two cases of complete permanent external biliary fistula which we have repaired were cured by a method which we published in *The Surgical Clinic of North America,* Lahey Clinic number, 1924. It had previously been done successfully, but not reported, on a patient without our knowedge also by Dr. Hugh Williams, of the Massachusetts General Hospital, Boston. It consists of carefully preserving the fistulous tract down to the liver and implanting it into the stomach or duodenum. In one patient we transplanted the fistulous tract into the duodenum successfully six years ago, and in the other into the stomach five years ago. Both patients are today alive and well without jaundice and with bile-colored stools, one after having discharged all of her bile through an abdominal biliary fistula for twenty months, and the other after having discharged all his bile through an abdominal fistula for three months.

The principle upon which I first undertook the operation was that if an external biliary fistula would remain open—and we know that it will—it must do so only because the secretory pressure of bile is greater than is the ingrowth or contractility of the scar tissue in the wall of the fistula. I therefore assumed that if an external biliary fistula would remain open, then if I could convert it into an internal one it would likewise remain open, which has proved to be so in these two cases and in cases since reported by other operators. The method will be illustrated and described with the slides. (Figs. 5 to 7.)

One of the most difficult decisions to make in dealing with biliary tract disease is whether or not to advise surgery in a patient who is jaundiced but who has not had the pain which is characteristically associated with jaundice due to cholelithiasis. We all know how undesirable it is to operate upon patients whose jaundice is of infectious origin, and how particularly undesirable it is to administer a general anæsthetic to a patient with jaundice of

infectious origin because of the lowered resistance of the infected liver to a toxic agent. Likewise, we are all anxious not to submit the patient with painless and progressive jaundice, which is due to malignancy, to the additional suffering and burden of an abdominal operation unless we can offer him some possibility of real relief, even though it be of but short duration. In this connection we have found Courvoisier's law of real service. Courvoisier's law is that in the presence of jaundice a dilated gall-bladder is indicative that the obstruction to the bile flow is due to malignancy, while a contracted gall-bladder indicates that the obstruction is due to stone. I have several times talked of the value of this law. It is at once evident, however, that only the portion of the law which has to do with the dilated gall-bladder is of value, since the dilated gall-bladder may be felt through the abdominal wall, while the contracted gall-bladder may be demonstrated only at autopsy or operation, and is therefore of little value in arriving at a pre-operative diagnosis or as an aid in determining the plan of treatment to undertake.

After considerable experience with cases of painless jaundice of the type spoken of, we have modified the law for our purposes as follows, and have found it with these modifications to be of greater service. In a patient with painless and progressive jaundice, with persistently clay-colored stools and with a dilated gall-bladder, the obstruction is quite certainly due to malignancy either of the head of the pancreas or of that portion of the common duct below the part where the cystic duct enters it. In such a case operation may be justifiably urged, since a cholecystenterostomy, the anastomosis of the gall-bladder to the stomach, duodenum or jejunum may be done with assurance of relieving the jaundice, thus ridding the patient of the intolerable itching and the undesirable hebetude which is so frequently associated with jaundice.

When, however, the above-stated features are not all present, that is, when painless and progressive jaundice together with persistently clay-colored stools, but without dilation of the gall-bladder, are present, then almost never will surgery be advisable, since, if the condition is due to infectious jaundice, surgery is not wise, and if it is due to malignancy, the obstruction must have extended above the junction of the cystic duct and common duct, or the gall-bladder is so destroyed by fibrosis that it will not dilate, either of which conditions will prevent sidetracking the flow of bile up the cystic duct through the gall-bladder and into the bowel. The only exception to the last statement in painless and progressive jaundice will be the occasional rare case of silent common-duct stone. In our experience, however, silent common-duct stones may be differentiated from biliary obstruction due to malignancy by a careful watch and record of the stools for bile, since in painless jaundice due to malignancy the obstruction is, as a rule, progressive and complete, so that the stools are usually consistently and persistently uncolored, while in biliary obstruction due to stone there are repeated periods in which bile can be found in the stools. This latter simple point in the differentia-

tion of silent common-duct stone from malignancy is of great value, and often not made use of.

CONCLUSIONS

The diagnosis of non-calculous chronic cholecystitis is difficult and uncertain. Removal of the gall-bladder may be justifiably advised when adequate investigation has failed to reveal conditions other than cholecystitis as the cause of the symptoms; when medical measures have failed to relieve the condition; when cholecystography shows evidences of an abnormal gall-bladder; and when the symptoms are of sufficient magnitude to make surgery worth considering.

There are no harmless gall-stones. The diagnosis of gall-stones should be made as early in the disease as possible and operation undertaken as early as possible to avoid the undesirable results of long-standing cholelithiasis.

Strictures of the main bile ducts most commonly follow operative injuries and can for the most part be repaired by a plastic operation on the duct.

Courvoisier's law as modified here has been very helpful in deciding for or against operation in cases of painless and persisting jaundice.

MORTALITY OF ENTEROSTOMY IN ACUTE ILEUS*

IMPROVEMENT NOT REFERABLE TO THE TIME ELEMENT

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In an earlier article by the writer, attention was called to the importance of the time element in cases of acute ileus.[1] In another paper [2] an attempt was made to show that this time element must be taken into account if one desired to make a fair comparison of results between two series of acute ileus cases; because of all factors contributing to the excellence of results in this condition early operation is apparently the most important. (See Tables III and IV.)

The greatest loss of time usually occurs before rather than after the patient has been seen by a surgeon and this is unavoidable at present. Not until the public and the profession in general have been made to understand (at least as clearly as they do now in regard to acute appendicitis) that time is of the essence and that delay means added danger will the mortality curve in acute ileus fall to a point where one can look at it without a shudder. Surgeons have been saying this since the day of Sir Frederic Treves and it is still true.

It is important, therefore, to examine critically all other factors which may affect the outcome. Among the technical procedures, enterostomy has been perhaps the most warmly advocated. Extravagant claims have been made for it by certain writers. But enterostomy, like any other surgical procedure, must be used in the right way and at the right time to be most effective. And its effectiveness cannot be confirmed by enthusiastic impressions but only by carefully checked statistical evidence.

But here again the time element appears. In order to show that enterostomy has been instrumental in lowering the mortality of one series of acute ileus cases as compared with another, it must be shown also that the improvement was not due merely to earlier operation; in other words, that the two series compared include about the same proportion of late cases. The present paper is an attempt to do this.

An analysis of all cases of acute ileus operated upon during the period to be examined is first prepared. Part of such analysis is shown in Table I. Thus analyzed the cases are listed in groups based on the elapsed time between onset and operation. (See Table II.) From these lists one readily picks out cases that have been treated by enterostomy, and classifies the cases into enterostomy or non-enterostomy groups and determines the percentage of late cases in the whole series and in the two component groups.

Such an analysis has been made of the acute ileus cases operated upon during the past twelve years at the Presbyterian Hospital in New York City.

* Read before the Southern Surgical Association, December, 1928.

TABLE I.

Acute Ileus Series

Analysis of Case Histories

No.	Diagnosis	Time O-A and A-O	Operation	E or Non-E	Condition of Bowel	Recovered	Died	Age	Apparent Cause of Death	Remarks
36662	Acute ileus, peritoneal abscess, pelvic gangrene of intestine	Not stated P. P. A. V. S. L.	Drainage of abscess	Non-E	Gangrene		+ 36 hrs. post-op.	50 yrs.	Gangrene of colon beyond colostomy	Apparently a hopeless case. Gangrene of distal loop, colostomy.
67643	Acute ileus, peritoneal adhesions, broncho-pneumonia, thrombophlebitis, saphenous vein	36 hrs. O-A 2½ hr. A-O	Jejunostomy, enterostomy	E worked well	Markedly congested and distended	+		46 yrs.		Both ileostomy and jejunostomy worked well. Difficult case with matted adhesions. Tried Holdens bowel evacuation unsuccessfully
69847	Acute ileus Ca. of transverse colon, Acute uremia, chronic ileus	15 hr. O-A 39 hr. A-O	Cecostomy (primary), partial colectomy, colo-colostomy	E worked well	Distended		+ 7 days after 1st op. 24 hrs. after 2nd op.	59 yrs.	Acute uremia	Admitted to medical ward explains delay in this case. Recovered from acute ileus but died following colectomy.
57878 1st Admission	Chronic appendicitis, peritoneal adhesions, acute ileus (post-op.)	3 to 5 days O-O	Appendicectomy, enterostomy (secondary), division of adhesions	E drained well	Distended	+		60 yrs.		Delay due to ileus being remittent type and partly yielding to palliative treatment. Enterostomy done five days after appendicectomy worked well.
57878 2nd Admission	Acute ileus, peritoneal adhesions, lat. ventral hernia	Not Noted	Exploratory celiotomy, partial enterectomy, entero-enterostomy	Non-E	Distended and wall thinned out	+		64 yrs.		Four years after previous acute ileus. No history. P. D. Dr.
69626	R. I. I. H. strangulated acute ileus	7 hr. O-A 2¾ hr. A-O	Repair of hernia	Non-E	Several infarcts. Distended	+		18 yrs.		
67979	Acute ileus, peritoneal adhesions, peritoneal band	3 days O-A 14 days A-O	Division of adhesions	Non-E	Slight distention	+		35 yrs.		Acute ileus subsided under palliative treatment and exploration was delayed two weeks to get him into better condition. Definite obstruction by band.
69048	Acute ileus, disruption of operation wound	48 hr. O-O	Exploratory celiotomy: 1. Suture of disrupted operation wound. 2. Jejunostomy	E	Slight distention		+ 20 hrs. post-op.	56 yrs.	Shock from disruption and operation. Pneumonia? Paralytic ileus.	Clinically acute ileus but no obstruction found at operation. Jejunostomy done as last resort. Disruption followed gastric lavage.

The twelve-year period was divided into three periods of four years each. A comparison between two of these four-year periods was published in 1927.[2] Comparison with a third period (1924-1927) is offered in Table V. A study of this table indicates:

TABLE II

Acute Ileus Series

Time—Group Analysis of Case Numbers, 1924-5-6-7

N. B. Letter E following a number indicates enterostomy.

1–12		12–24		24–48		48–72		72+		No Stated Time		
R	D	R	D	R	D	R	D	R	D	R	D	
69626 60104 62984 58834 62011 64232 64846 69038 54436E	58866E	69073 68940 63826E 61393 66599E 61868 57572E 56524E	69037E 65635 63321	69633E 64681 67602E 59956 60956 66165E 64890 65098 65699E 64011E 59955 67357E 61364E 65205E 61863E	67643E 64270 67714 48756E 61970E 67305E	62875E 61749E 62937E 60815E 60323E 59873E 66639E	69847E 69048E 67169E 60770E 60870E 63500E 67085E 64779E	57878E 67979 68496E 68289E 57905E 66076E 64668E 65071E 60518 58793 61408E 63877 65930 56366E 67139E 64832E 65035E 65748E	68750E 69350E 69886 68390 46089E 67359 60878E 66644E 66240E 58663E 61398E 63566E 64033E 63656E 59659E 36852E 45511E 64932E 65715E 60759E 58868E 58496E 65259E 50788E 67281E 67079E	57878 60815E 35550	36662 53244E 58943E 53244E	
9	1	8	3	15	6	7	8	18	26	3	*1 Series*	
1	1	4	1	9	4	7	8	13	23	1	*3 Enterostomy*	
8	0	4	2	6	2	0	0	5	3	2	*1 Non-E.*	

	Total Cases	Recovered	Died	Mortality—Per cent.
Series	108	60	48	44.4 (61% late cases)
Enterostomy Grp.	75	35	40	53.3 (73% late cases)
Non-enterostomy Grp.	33	25	8	24.2 (33% late cases)

1. That the diagnosis of acute ileus is being made more frequently. Shown by increase in number of cases in later periods.

2. That the diagnosis is being made a little earlier. Shown by smaller percentage of late cases in later periods.

3. That the average mortality has been materially reduced during the last eight years and especially during the last four years.

4. That enterostomy is being used more frequently as an adjunct in the treatment of these cases (one-third of the cases in first period—one-half of the cases in second period—three-quarters of the cases in third period).

5. That about the same number of cases in each period did not have enterostomy done.

Further study of the table shows:

1. That there has been a greater reduction in the average mortality of the cases treated by enterostomy than in those not so treated (38 per cent. lower in enterostomy group; 29 per cent. lower in non-enterostomy group).

2. That the reduction in average mortality of the whole series may be accounted for (in part, at least) by the reduction in percentage of late cases. (Late cases reduced 20 per cent.; mortality reduced 22 per cent.)

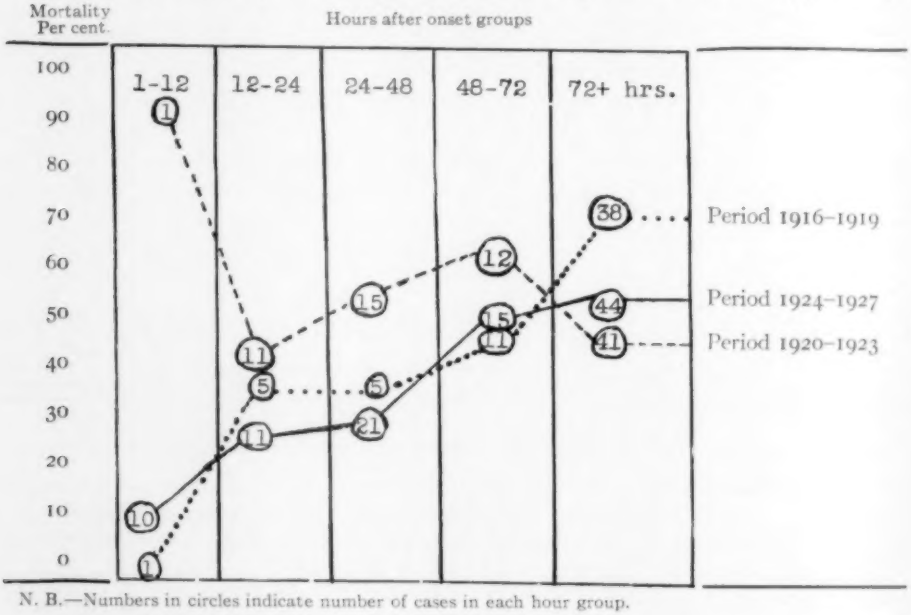
3. That the reduction in average mortality of non-enterostomy group may be accounted for very largely by the reduction in percentage of late cases

TABLE III

Acute Ileus Series

Time—Mortality Curves (compared) for Three four-year Periods

Shows average mortality rate rising with increased delay between onset and operation.



N. B.—Numbers in circles indicate number of cases in each hour group.

in this group: Late cases reduced 59 per cent. Mortality reduced 29 per cent.

4. That the reduction in average mortality of enterostomy group cannot be accounted for in this way: Late cases increased variable per cent. Mortality reduced 38 per cent.

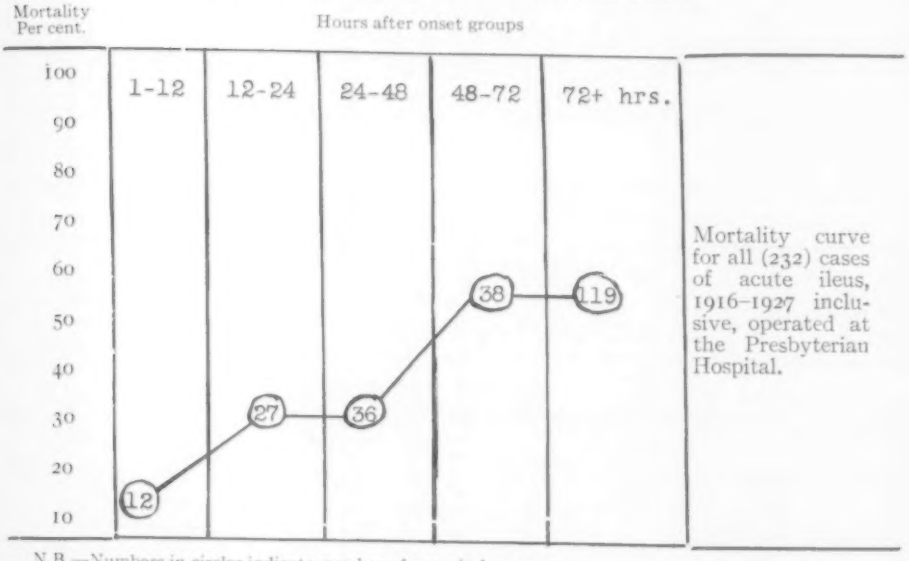
This last observation appears to be of real significance. It has been seen in Tables III and IV that the average mortality of cases of acute ileus operated upon later than forty-eight hours after onset is greater than the average mortality of those operated upon earlier than forty-eight hours after onset. Therefore it appears obvious that when the percentage of late cases is increased in a group, the average mortality for that group of cases must also be increased unless some other factor than the time element steps in to

alter the expected result. Now in this enterostomy group of acute ileus cases at the Presbyterian Hospital the percentage of late cases during the two later periods is greater than during the first four-year period examined. We should therefore expect the average mortality to be greater. But the contrary has happened. The average mortality has materially decreased. Comparing the second period with the first, we find that the late cases increased 15 per cent. while the average mortality decreased 13 per cent. Comparing the third period with the second, we find that the late cases decreased 6 per cent. while the average mortality decreased 20 per cent. Here we may say that part of the average mortality decrease is due to a larger percentage of early cases in the third period than in the second. But this can only partially explain it for

TABLE IV

Acute Ileus Series

Time—Mortality Curve for Twelve-year Period



N.B.—Numbers in circles indicate number of cases in hour group.

the fall in mortality is three times greater than the fall in percentage of late cases. Comparing the third period with the first we find an increase of 9 per cent. in the number of late cases but a decrease of 38 per cent. in the average mortality. Part of this decrease in mortality may be due to the fact that the enterostomy group of the third period is three times larger than that of the first period and therefore less influenced by the possible factor we call luck (*i.e.* the small group of the first period may have contained a relatively large proportion of unusually bad cases). But even allowing for these factors it appears that the discrepancy is too great to be accounted for in this way. A logically to-be-expected increase in average mortality has been replaced by a definitely marked decrease in the enterostomy group of cases. What factor is responsible for this? Certainly there has been some change in the adjuvant treatment in cases of acute ileus (whether with or without

enterostomy) during the past eight years. Greater pains have been taken to protect these patients against cold and shock, to reduce intestinal distention before and after operation, to suport the circulation and to replace water losses. But these while very important are not, one feels, the critical elements involved. There is evidence indicating that the most important factor of danger in acute ileus cases is intestinal damage [3] leading to absorption toxemia or perforation peritonitis. Intestinal damage is primarily due to intestinal over-distention (in non-strangulated cases, at least). If these statements are

TABLE V

Acute Ileus Series

Comparison of Mortality by Four-year Periods

Entire Series

No. of Cases	Period	Mortality—Per cent.
60	1916–1919	66.6 (81% late cases)
80	1920–1923	53.7 (66% late cases)
108	1924–1927	44.4 (61% late cases)

"Late cases" are those allowed to go more than forty-eight hours without operation.

Enterostomy Group

No. of Cases	Period	Mortality—Per cent.
22	1916–1919	90.9 (64% late cases)
38	1920–1923	77.7 (79% late cases)
75	1924–1927	53.3 (73% late cases)

Non-enterostomy Group

No. of Cases	Period	Mortality—Per cent.
38	1916–1919	52.6 (92% late cases)
42	1920–1923	34.0 (55% late cases)
33	1924–1927	24.2 (33% late cases)

correct whatever means is most effective in preventing or relieving this over-distention is therefore the most important factor in removing the danger: the critical factor in decreasing the average mortality. Enterostomy, done at the right time and in the right way, is the most effective means we have at present to relieve and to prevent intestinal over-distention and anæmia. Now, in the groups of cases here presented, the group treated by enterostomy has shown a slightly larger decrease in average mortality than has the group not treated by enterostomy. Moreover, it must be noted that the decrease in the average mortality of the non-enterostomy group was predisposed to by a marked decrease in the percentage of late cases while this was not true of the enterostomy group. The adjuvant treatment was similar in both groups of cases. Therefore it seems fair to assume that the enterostomy procedure itself was

the critical factor in lowering the average mortality of the group of cases so treated. And, because the enterostomy group was more than twice as large as the non-enterostomy group it assumes greater responsibility for lowering the average mortality of the entire series of acute ileus cases. Thus, it would appear that the performance of enterostomy on a large proportion of the cases in the series of acute ileus cases at the Presbyterian Hospital in the period 1924 to 1927 did definitely influence the average mortality in a favorable manner.

Conclusion.—There is statistical evidence to indicate that enterostomy is of value in the treatment of Acute Ileus.

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ILEUS FOLLOWING RIB FRACTURE

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Report of Case.—Male, fifty-three years of age. Negative medical history. September 18, 1928, while riding on a street car, he fell, striking his chest against the edge of a step. Immediately after this he drove fifteen miles to his suburban home to see a physician, who took him to a hospital where an X-ray examination showed fractures of the eighth and ninth ribs on the left side. The chest was strapped with adhesive and the patient went home. On the following day the patient suffered no pain of any consequence. He had a normal bowel movement, but by noon he began to become slightly distended. On the following day there was no bowel movement and the distention was increased. That night there was a projectile, ill-smelling emesis. The third day after the accident, there was still no bowel movement and the distention became even more marked. By this time the vomitus had a fæcal character. The patient appeared to be very ill with elevation of pulse rate and temperature. The man was moved to the Evanston Hospital, where the abdomen was explored through a left rectus incision. The small bowel was found to be markedly distended but careful search failed to reveal any obstruction. The abdomen was closed without drainage and without the performance of an enterostomy. The post-operative course was stormy. There was marked distention and gastric dilatation, the latter being evidenced by the accumulation in the stomach of brown, ill-smelling fluid. During the first twenty-four hours the treatment included the following: Four "1-2-3" enemata, three lavages, two hypodermoclyses, proctoclysis, hot turpentine stupes, small doses of milk of magnesia, seven ampoules of pituitrin, two ampoules of digifolin. On the second post-operative day four enemata, one hypodermoclysis, and two ampoules of pituitrin and three ampoules of digifolin were given. On the third day the patient began to expel flatus freely and from then on his convalescence was uneventful. He walked out of the hospital on his fifteenth post-operative day.

A careful search of the literature reveals but four other cases. These cases together with the author's are summarized in Table I. It will be noted that the patients were all males. The ages varied from forty-three to sixty-six, the average being fifty-six. The symptoms of all cases were very similar: cessation of bowel movements, increasing distention, and vomiting. A pre-operative diagnosis of intestinal obstruction was made in four cases; in one, mesenteric thrombosis. Four cases recovered and one died. Laparotomy was done in all cases. In three cases, enterostomy was done and all recovered. In the two cases where enterostomy was omitted, one (the author's case) recovered and one died. From this very small group of cases it would seem that enterostomy might be the safer procedure, although the very energetic post-operative treatment given in the author's case may account for his recovery. Whereas it might seem from the author's case that recovery might be possible without operation, such a course could never safely be taken where the liability of mechanical obstruction is so great. The employment or omission of enterostomy must vary with the judgment of the surgeon. Perhaps a larger series of cases in the future will throw light upon this question.

TABLE I

Author	Date	Sex	Age	Occupation	Previous history	History of present illness	Examination and course	Diagnosis	Operation	Post-operative course	Result
Adams, J. E. ANNALS OF SURGERY, 1910, vol. li, p. 102	1907	M	66	Interpreter	Negative except for blood from rectum on two or three occasions.	Three days before admission to the hospital, patient fractured 8th, 9th, 10th, 11th ribs on right side near their angles, by fall against bannister. Ribs were strapped. No bowel movement since accident despite laxatives and enemata. Dark vomitus on third day.	Excess of fat. Pulse 120; respiration 40; temperature 99.6. Abdomen generally distended. Some tenderness in the left iliac fossa.	Intestinal obstruction? Carcinoma of iliac colon?	Right rectus incision. No lesion save distention found. Same result with left-sided incision. Closure without drainage.	Vomiting, profound shock, thirst, mental disturbances. Peroxide enema caused evacuation of fæces and flatus.	Died forty-eight hours after operation. Post-mortem: Small bowel and cæcum distended; colon collapsed; no obstruction to bowel.
Adams, J. E. *Ibid.*	1908	M	60	Bricklayer	Negative	Fell eighteen feet from ladder and sustained fracture of 8th and 9th right ribs near their angles. Severe contusion of back. Admitted to hospital day of accident.	Bronchitis treated by steam kettle; abdomen distended on third day; respiration 32; no bowel movement since admission; enemata gave only a little flatus; fourth day, distention, hiccough, vomiting, cyanosis, feeble rapid pulse.	Intestinal obstruction.	Gas and fluid fæces withdrawn from most distended loop by needle. Temperature. Improvement with eserin. Sixteen hrs. later, winged catheter inserted in loop.	Patient comfortable two days after operation. Fistula healed eighth week.	Recoverd.
Ralphs, F. G. Brit. Jour. Surg., 1926, vol. xiii, p. 559	1926	M	60	Storekeeper	Negative	Six days previous to admission, patient slipped on pavement and fell heavily on right side. Chest strapped. Bowels failed to act after laxatives and on the fifth day patient became distended.	Subcutaneous emphysema X-ray; fractured 6th and 7th ribs between angle and sternum. Great distention. Pulse 90; temperature normal. Distention increased despite eserin and pituitrin. Fæcal vomiting day after admission.	Intestinal obstruction.	Enterostomy; local anæsthesia. Distended loop sutured to parietal peritoneum; catheter tied in place	Bowels moved normally after fifth day; wound healed in five weeks.	Recovered.
Vandell, D. T. J. A. M. A., 1926, vol. lxxxvii, p. 169	1926	M	43		Negative	Admitted to hospital following automobile accident, and on same day.	X-ray; fractured 12th rib right scapular line, 8th and 9th rib right one inch to right of vertebra. Patient strapped and put to bed. Next day pain, vomiting, abdominal distention, delirium.	Mesenteric thrombosis; Perforation of gut; rupture of diaphragm.	Two days after admission; distal three feet of ileum only distended. Jejunostomy.	Stormy. Distention, vomiting, delirium; blood transfusions; fluid and gas through tube seven days.	Recovered.
Christopher, F.	1928	M	53	Attorney	"Ptomaine poisoning" in 1910	September 18, 1928, patient fell while on a street car and struck chest against a step. After this drove his automobile fifteen miles to a doctor. X-ray showed fracture of the 8th and 9th ribs left side, posterior axillary line.	September 19, 1928, normal bowel movement; no pain; slight distention by noon. September 20, 1928, no bowel movement, increasing distention; projectile ill-smelling emesis at night; dyspnœa. September 21, 1928, no bowel movement; fæcal vomiting; increasing distention.	Intestinal obstruction.	Sept. 1, 1928. Left rectus incision. Distended small bowel. Splenic region explored. No obstruction found. Closure without drainage.	Stormy. Frequent turpentine stupes, lavages, and enemata. Hypodermoclyses. Walked out of hospital fifteenth day post-operative.	Recovered.

The mechanism of the production of the ileus is not clear in these cases. In 1906 Starling (quoted by Adams) said: "Stimulation of the splanchnic causes complete relaxation of the lower part of the ileum with the rest of the small bowel, but it produces a strong contraction of the muscle fibres forming the ileocolic sphincter." Where the fractures are close to the sympathetic chain it is conceivable that the latter might become irritated. But in Ralphs' and the author's cases the fractures were some distance from the vertebral column. Moreover, as pointed out by Ralphs, there are many cases of rib fractures, both single and multiple, which are not accompanied by ileus. Hypotheses suggested by Ralphs are an inhibition of peristalsis by irritation of the abdominal sensory nerves or traumatic lipæmia with fat embolism.

VON RECKLINGHAUSEN'S DISEASE

WITH SARCOMATOUS DEGENERATION OF A DEEP FIBROMA

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Von Recklinghausen's disease, or "multiple neurofibromatosis," has been termed a constitutional anomaly. In 1849, R. W. Smith first described the gross anatomic characteristics. Virchow, in 1863, found that the tumors had their origin in the connective tissue of nerves. In 1882, von Recklinghausen grouped the signs and symptoms into a disease unit, characterized by multiple cutaneous tumors, pigment anomalies, and elephantiasis-like formations. There are associated congenital malformations, psychic disturbances, and often more or less characteristic bone changes. Herbitz states that one-fifth of his cases had an hereditary basis.

Fig. 1.—Showing asymmetry of face, areas of pigmentation, and several small scattered cutaneous fibromata.

The disease is rare, but four cases appearing in the records of the combined First Medical and Surgical Services of the Bellevue Hospital during the past ten years. The following case is of interest as it embodies practically all of the lesions described by the various writers on the subject, including malignant degeneration of a deeply seated tumor. Added interest lies in the fact that although careful search was made for nerve tissue in many so-called "neurofibromata," in only one specimen, that from the iliohypogastric nerve, was any evidence of neurogenic origin found.

Case History.—H. H., Bellevue Hospital, 6220; twenty-two years of age; German; painter by trade. Admitted to the First Surgical Division March 1, 1927.

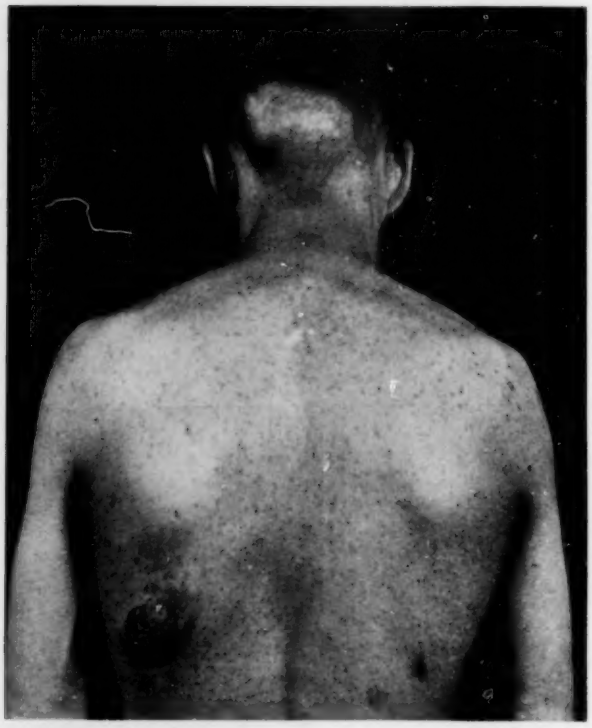

FIG. 2.—Note the difference in size and shape of the ears; the occipital tumor; the compensatory scoliosis; the pigmentation which is most marked about the waist; and in the left subscapular region, a large, pigmented, cutaneous fibroma.

There was no family history of a similar condition. From birth there had been an enlargement of the soft tissues about the right ankle and foot. During his youth the patient had noticed the gradual appearance of pigmented areas over the body and of soft, painless nodules scattered over the back, chest, abdomen, and extremities. Five years before admission he noted a pea-sized nodule over the occiput which did not increase in size until two months previous to admission. It was the subsequent rapid growth of this nodule which brought the patient to the hospital.

Physical examination showed a robust man of twenty-two, not acutely ill. He appeared mentally below par. There was asymmetry of the face with flattening of the left malar bone. The left eye was placed slightly lower than the right, and the right ear was larger and more protruding than the left. In the occipital region there was a hard, rounded, slightly movable mass eight centimetres in diameter, attached deeply. Over the back, chest, abdomen, and upper thighs there were scattered areas of dark brownish pigmentation varying from one-half to three centimetres in diameter. Over the same areas there were many soft cutaneous tumors; some slightly raised and pigmented, others flattened and without pigment. There was an irregular, soft, angiomatous mass in the region of the right ankle. There was marked enlargement of the right tibia and of the bones of the right foot, the tibia being three centimetres longer than its fellow on the left. There was a compensatory scoliosis. No abnormality of the internal organs or of the genitalia was noted. X-ray plates of the right lower extremity showed irregular enlargement of the tibia and fibula with what appeared to be small bone cysts about the epiphyses. (Figs. 1, 2, 3 and 4.)

FIG. 3.—Asymmetry of the bones of the lower leg with overgrowth of right tibia, fibula, and bones of the foot. Note the large fibromatous growth about the right ankle.

A diagnosis of von Recklinghausen's disease with sarcomatous degeneration of a "neurofibroma" was made.

Operation March 4, 1927. The occipital tumor was removed and found to consist of firm, lobulated fibrous tissue, encapsulated save at the base where it merged with muscle. There was no evident involvement of the bone. A cutaneous nodule from the chest wall and one from the thigh were also removed. Radiotherapy was advised but the advice was disregarded.

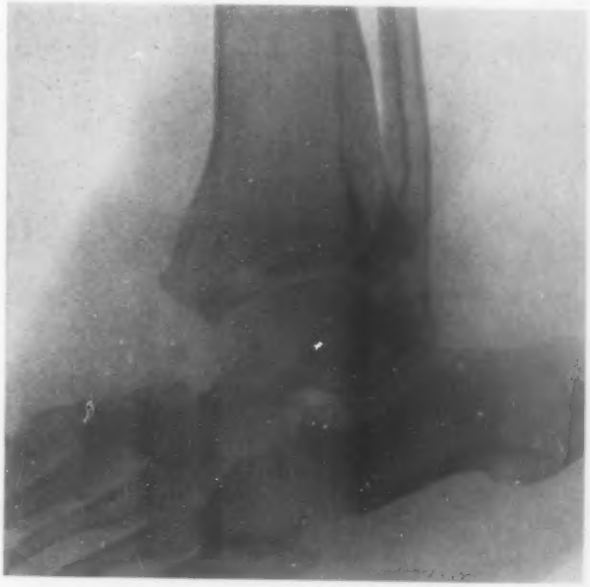

FIG. 4.—X-ray of right foot and ankle, showing the deformity of the bones with the presence of "bone cysts" in the lower third of tibia and fibula.

Pathological Report.—(*a*) Occipital tumor: "The specimen consists of a lobulated, circumscribed, apparently encapsulated mass eight centimetres in diameter. On section the tumor is moderately dense and consists of two lobes, each surrounded by its own thin but firm capsule. The cut surface is glistening white and shows a mass of fibres arranged in the form of whorls. Microscopically, the tumor is composed of both fibrous and cellular areas. The former consist of an interwoven mass of slender fibrils which closely resemble collagen fibres; the latter of long spindle cells. The nuclei of these cells are rounded, moderately hyperchromatic, and show an occa-

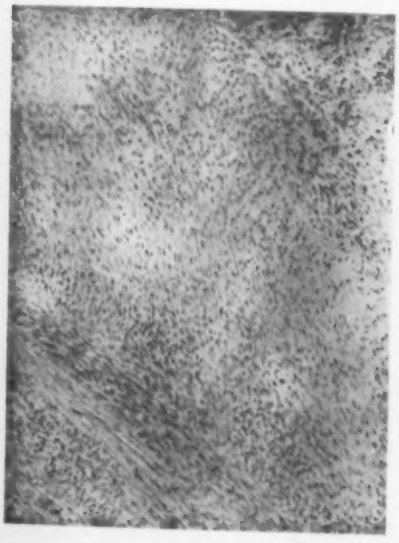

FIG. 5.—Occipital tumor at time of first removal.

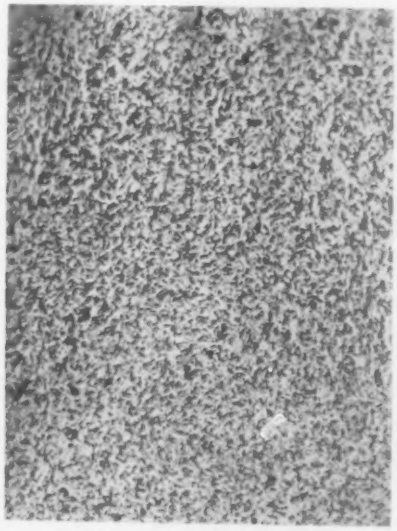

FIG. 6.—Section of fibroma of chest wall.

sional mitotic figure. The tumor as a whole is relatively avascular. The few blood vessels present are well formed and are lined by endothelium. *Diagnosis.*—Fibrosarcoma." (As the result of a recent study of a large series of fascial tumors, the micro-

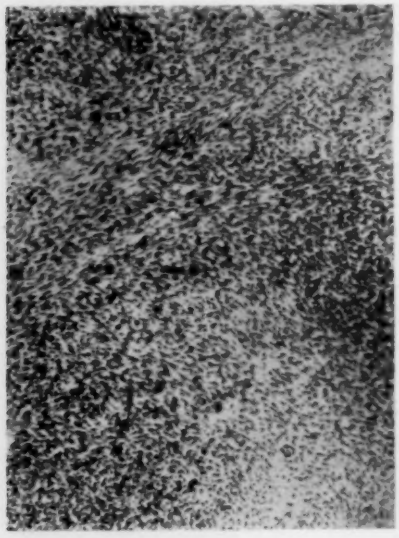

FIG. 7.—Occipital tumor at time of second removal. (Compare with Fig. 5.)

FIG. 8.—Metastatic growth in pleura and adjoining lung substance.

scopic picture of many of which was similar to that of the one just described, it was felt that this tumor was of the locally malignant type as opposed to the purely benign or to the metastatic. (Fig. 5.)

FIG. 9.—Neurofibroma of iliohypogastric nerve.

(*b*) Tumors from chest wall and thigh: "That from the chest wall consists of a tough structureless mass of glistening white tissue replacing the subcutaneous fat and surrounded by an elliptical area of skin and subcutaneous tissue nine by five by one centimetres. The specimen from the thigh is similar as to gross appearance. Microscopically, the tissue of both specimens is rather cellular and consists of a mass of finely interwoven fibrils with prominent, moderately hyperchromatic nuclei. No mitotic figures are seen. The intercellular substance stains faintly and is finely granular. *Diagnosis.*—Fibroma." (Fig. 6.) Through the kindness of Doctor Stevenson, sections were stained for nerve fibrils by the methods of Cajal, Molnar, and Loyez. No nerve tissue was demonstrated. If no demonstrable evidence of neurogenic origin be present, it would seem a misnomer to refer to these tumors as "neurofibromata," basing the diagnosis on the probable site of origin rather than on the actual cellular make-up.

Eight months later the patient returned with the history of reappearance of the occipital growth two months previously. It was now practically the same size as at the time of his first admission. There was no change in the nature of the other tumors and the cutaneous masses which had been excised had not recurred. Second resection of the occipital mass November 17, 1927. The tumor was softer and more vascular. There was more extensive invasion of the muscle and erosion of the outer table of the skull. Radiotherapy was again refused by the patient.

Pathological Report.—"The specimen consists of an elliptical mass eight by four by three centimetres. On section, the tissue is extremely vascular and of a soft spongy consistency. The cut surface is grayish-white in color and has a somewhat trabeculated appearance. There is evidence of invasion of the scalp muscle. Microscopically, the tissue is exceedingly cellular and made up of short spindle cells arranged somewhat in the form of alveoli. Scattered throughout the section are circumscribed areas of degeneration. The blood supply is excessive with innumerable dilated blood sinuses lined by tumor cells. *Diagnosis.*—Spindle-cell sarcoma." (In comparing the microscopic picture of this neoplasm with that of the original, the anaplastic changes which have occurred during a period of eight months are strikingly apparent.) (Fig. 7.)

The final admission was four months later with the history of reappearance of the tumor one and one-half months previously, followed by rapid growth. The patient complained of constant headache and a slight unproductive cough. At operation it was found that the mass had perforated the skull and that the tumor tissue formed a heavy plaque over the occipital portion of the dura. There was considerable loss of blood and, in spite of transfusion, the patient died twelve hours following operation.

Autopsy.—"The occipital mass presents a picture similar to that on the previous admission. There is direct extension to the occipital portion of the dura with distant metastases to the visceral pleuræ, which are studded with firm whitish sarcomatous nodules. There is a small tumor arising from the sheath of the left iliohypogastric nerve which on section shows interlacing strands of fibrous and nerve tissue. The thymus is large and fleshy and weighs thirty-five grams. The remainder of the report corresponds with the physical findings on admission. *Diagnosis.*—von Recklinghausen's disease; spindle-cell sarcoma of occipital region with extension to the dura; metastatic sarcoma of visceral pleuræ and adjoining lung; cutaneous fibromata of trunk and extremities; neurofibroma of iliohypogastric nerve." (Figs. 8 and 9.)

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HEMIRESECTION OF A SOLITARY KIDNEY*

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Partial renal resection where there is a second normal kidney is an uncommon operation. Partial renal resection where there is no other kidney must be a very uncommon operation, as I can find only one case reported: that reported by Judd (in 1925) in the Annals of Surgery, vol. lxxxii, p. 458.

Judd resected the upper third of a single type kidney for stone and infected upper calices, in a woman, thirty-two years of age. The function of the kidney was normal before operation. The immediate effect of the operation was to run the blood urea up to 92 on the fourth day. Then the function returned to normal and the woman went successfully through a hard childbearing the next year.

Fig. 1.—Pyelogram showing congenital double right kidney. Left kidney removed surgically seventeen years previously. Note shadow of large stone in upper kidney and shadow of small stone blocking conjoined pelvis.

I wish to report a case of resection of one-half of a solitary kidney of the double type.

Case.—A man, forty-two years of age, entered the Hartford Hospital December 23, 1925, complaining of anuria and pain in his right kidney. His left kidney had been removed ten years before for stones. His present attack began three days previous to admission and he had passed no urine since. His temperature was 102°, pulse 110, leucocytes 17,000—80 over 20, blood pressure 130/90, non-proteid nitrogen 88.2 milligrams, creatinin 6. The man appeared acutely ill—with intense nausea and dry tongue.

A catheter passed up to the right kidney brought very pussy urine, flowing under pressure. The X-ray and pyelogram are shown in Figure 1.

Here was a man with a solitary double kidney with bifid pelvis. The upper kidney was completely filled with a stone cast, part of which had broken off and blocked the

* Presented before the New England Urological Association, May 1, 1929.

ureter at the junction of the bifid pelvis, causing an infected hydronephrosis of the lower good kidney.

The ureteral catheter was allowed to drain for twenty-four hours when it became blocked, making necessary an operation through a right lumbar incision to remove the obstructing stone, which was done without complication. The man recovered, and when his non-proteid nitrogen had returned to normal I advised a heminephrectomy, but he and his family declined. He left the hospital twenty-six days after admission.

Thirty-nine days later, February 27, 1926, he returned again with the same symptoms and a history of anuria for four days. His temperature was 103°, pulse 100, leucocytes 16,000—85 over 15, non-proteid nitrogen 55. He was intensely nauseated and looked ill. The X-ray showed that another fragment of the stone cast had broken off and blocked the bifid ureter. Immediate and radical resection of the upper kidney along with the removal of the obstructing stone was advised and accepted. This was done through a lumbar incision, taking twenty-two minutes to complete. Drains were put down to the upper pole of the kidney and to the incised ureter. Figure 4 shows the stone cast in the removed half.

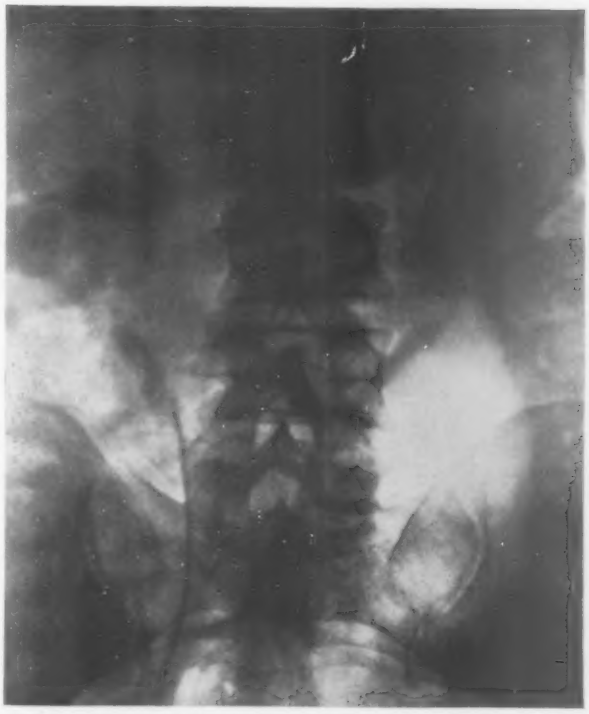

FIG. 2.—Pyelogram taken sixty-three days after heminephrectomy. Pelvis and ureter still distorted by blood clot.

FIG. 3.—Pyelogram three and one-half years after heminephrectomy.

This man soaked his dressing with urine for three days, then began to void normally, passing no more urine through the wound. His wound was firm in twenty-three days following

the operation. He left the hospital twenty-eight days following the operation. When he left his non-proteid nitrogen was normal and his phenolsulphonephthalein output was 22 per cent. in two hours.

Five weeks following this discharge he returned with hematuria. Cystoscopy showed the blood to be coming from the ureter, and the pyelogram showed the picture in Figure 2. This bleeding quickly cleared up. The patient returned at my request April 20, 1929, for pyelogram and function. He never felt better. His phenolsulphonephthalein is 48 per cent. in two hours and his pyelogram is shown in Figure 3.

FIG. 4.—Stone removed from upper kidney after resection.

In studying this case, by far the most interesting finding is the compensatory function in the remaining kidney, a function of 48 per cent. in two hours.

Now let us compare this functional result with almost an identical case reported by Doctor Young in the *Journal of Urology*, vol. i, pp. 17–57, 1917. The case of Young had a good kidney on the other side and there was no emergency operating as there was no obstruction to the ureter, so that Doctor Young could fortunately do a differential renal function before his heminephrectomy. The phenolsulphonephthalein output was 20 per cent. from the good kidney and 10 per cent. from the bad side in one-half hour. Four months following his operation, the output was only 5 per cent. on the operated side in one-half hour. There was no report after that.

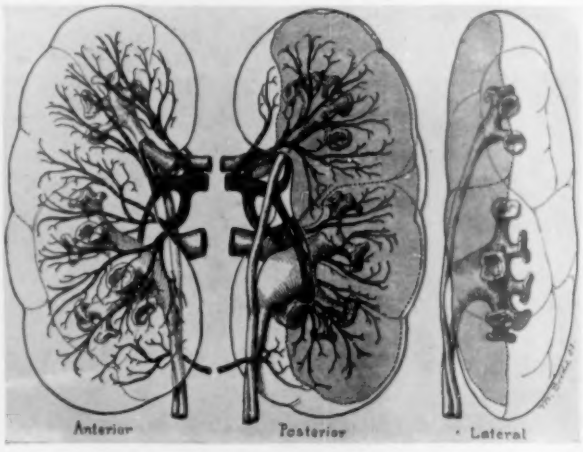

FIG. 5.—Three views of corrosion preparation of kidney with double pelvis. This represents, like the preceding figures, a type form. Note how complex the arterial circulation has become. There are now two posterior arteries, each skirting the renal pelvis as in a normal case. The lower posterior artery runs obliquely backward between the two renal pelves. The shaded areas represent the territory of the posterior vascularization. (From Kelly and Burnham.)

Judd has done a heminephrectomy in six cases where there was a functioning kidney on the other side. In three of these cases he has later had to remove the remaining half because of atrophy.

Judging from the clinical material which has been reported so far in enough detail to draw conclusions from, it would seem that Hinman's experimental work on compensatory function and disuse atrophy of kidneys is borne out. Unto the kidney that hath shall be given and the kidney that hath

not shall have taken from it even that that it hath. The surgical principles, therefore, become quite definite in regard to partial resection of kidneys: First, do not resect part of a kidney if there is a good kidney on the other side. Second, resection of the diseased part of a solitary kidney may give the remaining good part of the kidney an opportunity to compensate up to normal. I will say nothing about that large group of cases where there is bilateral renal pathology. Certainly, until we know to the contrary, this is a fertile field for conservative surgery.

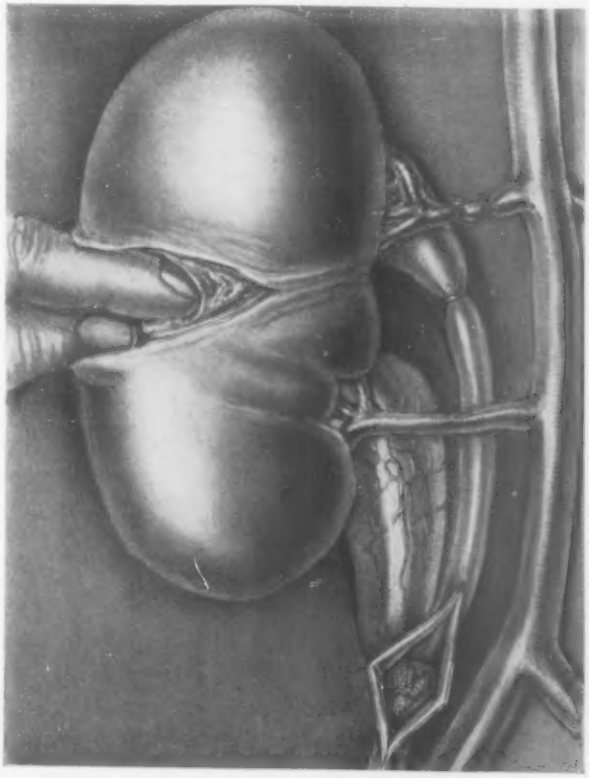

FIG. 6.—Showing method of relocat'ng double kidneys, with slight bleeding or danger of opening calices, and before ligating the pedicle.

In regard to the surgical technic of heminephrectomy in the double kidney type, I wish to suggest a method differing from both Judd and Young.

Judd says, "The vascular connections to the normal segment are first examined to make sure they are adequate. The pedicle to the remaining segment is then clamped, cut and ligated. The kidney should be resected through normal tissue, and a portion of this tissue left attached to the segment to be removed in order to avoid possible error and infection. The renal stump is closed with double interrupted or mattress sutures." He uses a knife in the resection.

Young says, "The vessels supplying the portion to be excised are ligated and divided. Incision is made at the junction between the healthy kidney and the diseased portion." He uses a knife, cuts a V-shaped hollow in the end of the kidney, takes great pains in curetting and closing calices that may be opened into, and closes the end with mattress sutures.

The blood supply in thirty-five cases of double kidney were shown by Eisendrath to be "one artery in fifteen cases, two arteries in fifteen cases, and three arteries in five cases." Figure 5, from Kelly and Burnham, shows Broedel's work on the blood supply of double kidneys. In my case of heminephrectomy, the patient was in a very desperate condition and the length of

time under an anæsthetic was an important factor. There was so much congestion and perirenal inflammation that to isolate the pedicle and identify the blood supply would have been a dangerous and difficult procedure. The furrow between the two kidneys was marked and after nicking the capsule in the furrow I found it as easy to separate those two kidneys with my finger (Fig. 6) as to enucleate an adenoma of the prostate. The line of least resistance is between the endings of the blood vessels. There was only a slight oozing of blood. No calix was broken into and the upper pus sack was unruptured. When the two kidneys are separated then the pedicle can be safely tied. The oozing from the raw end of the kidney was controlled by the slight pressure of mattress sutures—no attempt being made to close over the raw surface. A cigarette drain was put down to this surface, and no attempt was made to cover it with fat. The fact that my case had a urinary sinus only three days in spite of his pyelotomy, I think justifies the simplicity of the procedure.

SUMMARY

1. Partial nephrectomy of a solitary kidney can be successfully done with marked improvement in the function of the remaining portion of the kidney.

2. Partial nephrectomy is not a good surgical procedure if there is a good kidney on the other side—because its function gradually diminishes, due to disuse atrophy.

3. Where both kidneys are diseased, we have so far no cases of bilateral partial resections. This would be a most interesting group to get evidences of functional reactions on.

4. The simplest and safest method of heminephrectomy of the double kidney type for acute pathological conditions is to separate the two halves by blunt dissection with the finger. The kidney cleavage will be at the point of least resistance, *i.e.*, between the terminals of the blood vessels. This avoids the danger of destroying the circulation to the good kidney, and of cutting into calices. A few pressure mattress sutures to control the oozing of blood are all that is necessary to place in the cut end and it is not necessary to cover the raw end with renal capsule.

Avertin

RECTAL ANÆSTHESIA WITH TRIBROMETHYLALCOHOL

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The desirability of rectal anæsthesia especially in surgery of the head and neck and in the presence of pathology in the respiratory tract requires no comment. Ever since 1846 when Roux made his first attempt at rectal anæsthesia with an aqueous solution of ether, and 1847 when Pirogoff tried the rectal administration of ether vapor, numerous means have been elaborated with indifferent success in this type of surgical anæsthesia. The advent of local anæsthetics was naturally followed by a loss in interest in this method of inducing anæsthesia. However, the frequent incompetency of local anæsthesia, especially when dealing with hysterical or nervous patients together with the lack of adaptability of local anæsthesia in pædiatric surgery, has once more caused the attention to be focused on rectal induction. Gwathmey, in 1913, renewed interest in this method by publication of his ether-in-oil rectal anæsthesia, alone or in combination with hypodermic administration of morphine and magnesium sulfate. It has not become very popular, due to the uncertain rate of absorption of the ether from its oil mixture, and to the fact that frequently there occurred marked rectal irritation with the production of diarrhœa, tenesmus, bloody stools and ulceration of the mucosa. However, the search for a satisfactory rectal anæsthetic has apparently been successful, due to the recent elaboration by Willstater and Dusberg of a new drug, tribromethylalcohol, also known in the German literature as E 107 or Avertin, an anæsthetic that bids fair to supplant the use of ether by the rectum. This anæsthetic as shown by the literature has been used in over 100,000 cases with such marked success as to make it appear far superior to any method of anæsthesia at our command. The drug has not been available for use in this country but will appear in a short period of time. The European clinics have all had an opportunity of observing its efficacy and reporting their results. This communication will deal with the experience of the drug during my recent association with Professor Paul Sudeck at his surgical clinic for a period of eighteen months as well as a review of the literature emanating from the various surgical and gynæcological clinics. A brief description of the salient properties of the drug follows.

CHEMISTRY

Tribromethylalcohol is a white crystalline substance having a melting point of 79° C., easily soluble in water at 40° C. Its molecule is very labile, breaking down when heated above 45° C. with the formation of dibromacetaldehyde and bromic acid. Its chemical structure, as well as the products of decomposition, is shown by the following:

$$CBr_3.\ CH_2OH—HBr=CHBr_2.\ CHO$$

At this time it might be well to state that the dibromacetaldehyde is a highly irritant drug that easily causes rectal inflammation, and even ulceration. The presence of the aldehyde in a solution of tribromethylalcohol may be determined by adding to a solution of the drug a few drops of congo red. The formation of an orange color indicates that decomposition has not occurred, but the appearance of a blue color indicates the presence of the toxic dibromacetaldehyde and the solution should not be used. This test is obligatory before the solution is ever placed in the rectum.

ABSORPTION

The absorption of the drug is fairly rapid. Straub,[61] working at the Pharmacologic Institute of the University of Munich, found that 80 per cent. is absorbed in the first twenty minutes and 95 per cent. absorbed within the first two hours of the anæsthetic. During anæsthesia Sebening [45] has found it in a concentration of six to nine milligrams per cent. in the blood.

ELIMINATION

In the body the drug is detoxicated by its combination with glycuronic acid and eliminated in that manner by the kidney. Straub was enabled to recover 81 per cent. of the drug in this combination from the urine. Traces of bromine could be recovered from the sweat but none from the respired air or the fæces.

TOXICITY

When introduced hypodermically, perorally or by rectum, tribromethylalcohol causes a rapid induction of anæsthesia without any preliminary excitation. Unconsciousness and muscular relaxation similar to that observed under ether follows. Recovery from the anæsthetic is not comparable in any way to that observed with ether. Post-anæsthetic upsets are not seen, and experimental animals, and even man, recover in a way that is similar to a person awakening from a deep sleep. Lendle [33] has found that the toxic dose by rectum for the various laboratory animals is .5 to .6 gram per kilo body weight, and the anæsthetic dose for these animals is .25 to .30 gram per kilo body weight with a consequent therapeutic index above 1.7. He also compared the relative toxicity of the drug with various anæsthetics such as chloroform, ether, Gwathmey's ether-oil morphine and magnesium sulfate anæsthesia, and has found that the tribromethylalcohol was less toxic than any investigated except amyl hydrate. The slight toxicity is apparent when one observes how the animals, upon recovery from large doses, resume their ordinary activities and eat as though nothing had occurred.

LOCAL ACTION

A solution of the anæsthetic was without any apparent effect when placed in the conjunctiva, on the cornea, or in the gastro-intestinal tract, even when repeated a number of times.

RESPIRATION

In common with other anæsthetics the respiratory rate is slowed, but Straub [61] has found that the respiratory efficiency is maintained by an increase in the depth of breathing. During anæsthesia an increase in the rate could be effected by the use of such stimulants as carbon dioxide, lobeline, and caffeine, as has been shown in man by Killian.[26]

CARDIOVASCULAR SYSTEM

During anæsthesia with tribromethylalcohol there occurs a drop in the systolic pressure that varies from ten to thirty millimetres mercury. We have been unable to personally observe any fall greater than ten millimetres mercury. This fall is found only in the early part of the anæsthetic and there is a return to normal systolic pressure during the remainder of the anæsthetic. The diastolic pressure has a tendency to remain constant. The pulse rate may be slightly increased, rarely over 100, but the quality is unchanged and is the same as that observed before the induction of the anæsthesia. Unger and May [57] have studied a number of cases with the electrocardiograph and were unable to find any changes attributable to the anæsthetic. Bender [2] has found that the use of ephedrine may be successful in combating the preliminary fall of systolic pressure should conditions ever warrant it. In toxic doses the blood pressure falls rapidly and eventually circulatory collapse ensues.

PARENCHYMATOUS

Laboratory animals that were subjected to several anæsthesia with the drug day after day showed no injury to any organ. White rats with large doses of the anæsthetic repeated, so as to receive 100 inductions within seventeen weeks, showed no change in the parenchymatous organs. Indeed many of the animals became pregnant during the conduction of the investigations and gave birth to normal litters.

In addition one might add that the drug has been found in common with other narcotics to have a slight antipyretic effect. It has also been found to be antiseptic and was capable of killing staphylococci and colon bacilli in one minute when subjected to 3 per cent. solution.

PREPARATION AND ADMINISTRATION

The drug is slowly dissolved in water at 40° C., so as to make a 3 per cent. solution. Care must be taken to prevent the temperature from rising above that point as there is a likelihood of decomposing the drug with the formation of the highly toxic and irritating dibromacetaldehyde which Eicholtz [9] has shown was able to produce marked inflammation of the bowel that might even progress to necrosis. The dose varies from .1 gram to .15 gram per kilo of body weight, with an increase to .18 in the case of children. It has been the practice in the Surgical Clinic to also reduce the dose in the presence of large abdominal tumors and ascites. In using the drug for obstetrical purposes Hornung [24] advocates a dose varying from .05 to .06 gram per kilo body

weight, but the writer has no experience with the use of it in that field. As a rule a dose of .13 gram per kilo of body weight has given a good anæsthetic with pleasing surgical relaxation. In some instances an additional dose of .025 gram per kilo was given when a patient was poorly anæsthetized and did not relax properly. A few cases will require in addition to the above some ether inhalation and this has been the experience of others as well as at the Clinic. The anæsthetic will last about three hours and may be shortened by emptying the bowel and the use of cleansing enemas as is the practice after the termination of the operation. Florken and Mues,[13] of the Marien-Krankenhaus in Frankfort, report that 80 per cent. of their cases evidenced good surgical anæsthesia when doses above .13 gram per kilo were used and the percentage decreased with a decrease in the dosage. In the cases in which .10 gram per kilo was used only 60 per cent. showed a good anæsthesia. This has been our experience as well. Roith,[43] in a series of 214 cases in which a dose of .12 gram per kilo was employed, obtained a perfect anæsthesia in 61 per cent., a fair anæsthesia in 31 per cent. and a poor anæsthesia requiring supplementary ether in 8 per cent.

The method of administration as practiced in the Clinic is to give a preparatory enema the night before operation and on the day of operation to give .5 gram barbital (veronal). Others advocate the use of pantopan or morphine one or two hours before operation. The room should be darkened and the patient left undisturbed. The solution of the proper amount of the drug dissolved in a concentration of 3 per cent. in water is then introduced into the rectum by means of a rectal tube, this being performed slowly, the tube removed and the patient left in a quiet condition, until satisfactory anæsthesia and relaxation has occurred. This anæsthetic is indicated in practically every type of surgical procedure, but will probably find its greatest sphere of usefulness in surgery about the head and neck, in which great difficulty is encountered when using the orthodox inhalation anæsthesia. At the Clinic it has been employed in goitre surgery, thoracoplasty, breast resection, laminectomy, gastric surgery, appendectomies, hernias, amputations, with pleasing results. No unpleasant after effects were noted. No headache, no post-operative nausea or vomiting were evidenced. Post-operative lung complications as bronchitis and pneumonia were not seen. No ill effects attributable to the anæsthetic have occurred, in our experience. The post-operative care as far as the anæsthetic was concerned consisted of merely flushing out the lower bowel with several liters of water.

Roith [43] has reported on his experience with the anæsthesia in 214 cases. He obtained a good anæsthesia in 61 per cent., or 130 cases. About 31 per cent., or 67 cases, required a small amount of supplementary anæsthesia and in 8 per cent., or 17 cases, needed a large amount of additional inhalation ether. All types of surgical procedures are included in his report. Two cases evidenced rectal irritation as was shown by tenesmus and a few mucus stools, which he attributed to the improper overheating during the mixture of the solution. He believes that the anæsthetic is especially indicated in very ner-

vous and hysterical patients who are so easily terror-stricken when brought into the operating room. The horror of the operating room and the struggling during inhalation anæsthesia are obviated by the peaceful induction in the patient's own room. He relates the personal experience of a physician upon whom he operated for a large cervical carbuncle, in which the physician expressed his delight in the easy way that the narcosis was induced and the lack of pain during the operation and the pleasant post-operative recovery. He states that the anæsthetic is not contraindicated in diabetes or pulmonary tuberculosis. His oldest patient was eighty-six and the youngest six years of age.

Florcken and Mues [13] report on their experience with the anæsthetic in 180 cases. They obtained a complete efficient surgical anæsthesia in 116 or 64 per cent. of the cases. They call attention to the fact that the percentage of success closely follows the dosage of drug. With the use of .10 gram per kilo, but 50 per cent. of the cases gave a perfect anæsthesia, with the use of .125 gram per kilo about 60 per cent. perfect anæsthesias resulted, and with the use of .13 gram per kilo over 80 per cent. of the cases underwent a perfect anæsthesia. The youngest case operated was a child two and one-half years of age and the oldest a man seventy-nine years of age. They do not believe that even severe icterus is a contraindication to this anæsthesia, as four cases of severe icterus, including one of acute yellow atrophy, were successfully operated upon under tribromethylalcohol narcosis. Only two cases evidenced symptoms of rectal irritation as tenesmus, mucus and blood in the stools, and they cleared up readily. The only post-operative bronchitides observed were in five cases, all of which had required supplementary ether inhalation. They conclude that while the anæsthetic is not an ideal anæsthetic and that there is a difficulty in judging the proper dose, it should be adopted because it brings a quiet patient into the operating room; one who has not had the critical period when undergoing an inhalation anæsthetic; one who awakes nicely without nausea, vomiting, or headache and is not liable to post-operative lung complications.

Hornung,[24] of the Universitat-Frauenklinik of Berlin, reports on his observations with tribromethylalcohol in the rôle of an obstetrical analgesic. Using a dose varying from .05 to .06 gram per kilo he found that in a series of 100 cases he obtained good results in seventy-four; in twenty-four instances the analgesia was only fair, and in the two remaining cases absolutely valueless. He notes that twenty-seven cases had atonic bleeding and some disturbances in the separation of the placenta. In no case was there any effect upon the child. He stresses the fact that the kidneys and the liver must be in good functional order and consequently believes that its use in controlling the convulsions of eclampsia is contraindicated. The uterine contractions were somewhat weaker, but they increased in frequency and the length of labor was not markedly affected. The analgesia was gratifying in the majority of cases.

Nehrkorn [39] used the anæsthetic in a series of 180 cases, of all types and in all ages. The youngest patient was an infant of two months and the oldest

was eighty-four years of age. No pulmonary complications were noted in the cases in which Avertin alone was used. In the cases that necessitated the additional use of ether there were five instances of pulmonary complications. Kidney complications were not observed. He has successfully used the drug in two children to obtain an X-ray. One of his cases evidenced rectal irritation by having blood and mucus in the stools on the day following the use of the anæsthetic. He is in decided favor of using the anæsthetic, being especially impressed in the ideal way in which the sleep is induced.

Goecke [15] reports on his method of using tribromethylalcohol by rectal drop introduction. He introduces the solution by a drop method into the rectum, so regulating the flow that at first it is very rapid and then slowing the introduction as the amount introduced approaches a dose of .1 gram per kilo until a satisfactory anæsthesia is obtained. In this manner he has been able to obtain a good anæsthesia with doses of .08, .10, .12, .14, and .15 gram per kilo of body weight. The last dose was not exceeded in any case. He was well satisfied with the results in thirty cases in which it was tried and will report at a later period when he has been able to observe it in more instances.

Heynemann,[21] Killian,[26] Conrad,[7] and others have also reported on their experience with the rectal anæsthetic.

Hirsch [23] has used the anæsthetic as a supplement to gas, local and lumbar anæsthesia. Polano[42] warns one to be careful when supplementing this with a lumbar anæsthetic. Gossman [16] is especially enthusiastic in its use in surgery about the head and neck. Unger [56] and Ruge [44] think that it is especially indicated in complicated cases of lung cardiac pathology. Butzengeiger,[6] Frund,[50] Gruing,[17] Muhsam,[50] Nordmann,[41] Plentz,[50] Pribram,[50] Schmieden,[48] Vorschutz,[50] all report on its usefulness in thyroid surgery. Amersbach,[1] Behren,[23] von Eichen,[8] Kuthe,[31] and Toller,[54] have described its usefulness in otolaryngology. Roedeleus (?) reports on its success in urological surgery. Amersbach,[1] Butzengeiger,[6] Drugg,[60] Gossmann,[16] Peterman,[50] Unger,[56] and Wiechoski [50] were unable to find any interference with hepatic function in its use. Borchardt,[5] Kreuter,[30] and Nordmann [41] were unable to discern any ill effects upon the kidney. Numerous other European clinicians have reported upon the value of this anæsthetic and the bibliography appended below contains the reports of over 100,000 cases in which the anæsthetic was used without the report of a single fatality.

In conclusion it might be stated that while the last word upon tribromethylalcohol anæsthesia has not appeared, it approaches the ideal anæsthetic more closely than any other at our present command. It has its drawbacks, namely, its labile chemical constitution that admits of its decomposition with the production of the highly irritant dibromacetalydehyde, and its rapid absorption from the intestinal tract that may permit the flooding of the patient with a toxic dose that cannot be removed. These disadvantages can be obviated by care in the administration of a properly calculated dose with close attention to its preparation—in not overheating the solution. Its advantages are manifold: The peaceful induction in the patient's own room, the ease with which

surgical procedures about the head and neck may be carried out without the embarrassment caused by the administration of an inhalation anæsthetic, the restful post-operative awakening without nausea, vomiting, headache or depression, the lack of pulmonary or cardiac complications. These are admirable characteristics that more than offset the disadvantages enumerated above.

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THE INCIDENCE OF HYPOACIDITY IN CHOLELITHIASIS AND CHOLECYSTITIS

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The fact that the contents of the duodenum influence the amount of secretion of gastric juice has already been shown by Pawlow, Bickel, Cohnheim (1909–1910), and Sato (1914). Therefore, there is no doubt that in diseases such as cholelithiasis, which may lead to changes in the bile, there may also be produced changes in the duodenal contents and the latter, in turn, may influence the gastric secretion. Clinically, it has long been shown by our predecessors that patients suffering from cholelithiasis and those undergoing cholecystectomy often complained of gastric disturbances.

Concerning the gastric secretion in cases of cholelithiasis and cholecystitis much clinical and experimental investigation has been done, especially upon the question of hypoacidity. Hohlweg and Schmidt (1910) have noticed that most of the patients who had undergone a cholecystectomy or who suffered from cholelithiasis, presented either hypoacidity or anacidity. They sought to explain this condition on the basis of a dysfunction following the extirpation of the gall-bladder or a functional disturbance of the gall-bladder due to cholelithiasis. Hohlweg (1912) and Rost (1913) showed this to be the case in experimental animals and Rohde (1920), Behm (1921), Rydgaard (1921), and Dangshaft (1923) confirmed their findings.

However, Magnus (1913), Miyake (1913), Boss (1923), and others maintained that there was no connection between hypoacidity and anacidity on the one hand, and atrophy or failure of the gall-bladder or occlusion of the cystic duct on the other. To be sure, Toida found hypoacidity or anacidity in seventy out of eighty-two cases of cholelithiasis, but from his clinical and experimental investigation, he differed from Hohlweg in that he felt that there is no relation between the two conditions, because in cholelithiasis the repeated inflammation causes a disturbance of the bile secretion and this reflexly influences the gastric mucosa and, hence, the amount of hydrochloric acid secreted. Boss also stated that although he found a hypoacidity or anacidity in half of the cases of cholelithiasis, still it might be erroneous to consider it due to the extirpation of the gall-bladder.

We will not here vouch for the relation of hypoacidity and anacidity to functional disturbance or extirpation of the gall-bladder. Where the basis for the hypoacidity is not to be found, it exists, according to the assertions of the above-mentioned authors, as a fact in cholelithiasis or cholecystitis, and it remains as an irremissible clinical factor in the diagnosis of such

disease. Behm especially has shown this to be the case in the differential diagnosis of chronic cholelithiasis and peptic ulcer, which give similar symptoms. The degree of acidity after cholecystectomy is an important therapeutic guide and should always be determined post-operatively. For this reason we have determined the gastric acidity pre-operatively in the following cases: twenty-four with stones in the common duct, twenty-four of cholecystitis with or without stones, two of tumor of the liver, one of carcinoma of the gall-bladder, one of abscess of the liver.

There were also twenty-two cases, nine with common duct stone, and thirteen with cholecystitis, in which the gastric acidity was determined both before and after the operation. The results are given in Tables I and II, which give also the age and sex of the patient, degree of inflammation and the bacteria found in the gall-bladder.

If one considers a free hydrochloric acid of fifteen to thirty as normal, and over thirty as hyperacidity, and under fifteen as hypoacidity, then from the two tables one will group these forty-nine cases as follows: twenty-five with anacidity, thirteen with hypoacidity, nine normal, two with hyperacidity.

This gives 77 per cent. of hypoacidity or anacidity and compares with the results of others as follows: Boss, 56 per cent., 1913; Miyake, 69 per cent., 1913; Ohly, 68 per cent., 1913–1915; Wohl, 46 per cent., 1917; Wessel, 54 per cent., 1919; Fenger, 45 per cent., 1919; Matsuo and Sawada, 60 per cent., 1923.

These authors stated that cholelithiasis and cholecystitis usually were followed by hypoacidity and anacidity. In order to judge the assertions of hypoacidity and anacidity made by Hohlweg and others, we will analyze our results. In the forty-one cases the condition of the cystic duct was determined at operation and in fourteen of these, minor changes were found about the duct; in nine there was thickening and marked stenosis; in fifteen there was mild stenosis, and in three cases there was complete occlusion. The degree of hypoacidity did not correspond with the degree of change in the cystic duct as has been stated by Hohlweg and Schmidt. Cases No. 23 and No. 28, in which a scarred atrophy of the gall-bladder was found with a thickening and marked stenosis of the cystic duct, showed normal acidity. Case No. 22 showed hypoacidity, although mild in degree when compared with the marked hypoacidity and anacidity found in cases No. 18, No. 26, No. 32, and No. 53, in which the pathological changes in the gall-bladder and cystic duct were mild. Two cases, No. 12 and No. 49, in which the atrophy of the gall-bladder and sclerosis and stenosis of the cystic duct were so marked that there was probably complete dysfunction, showed normal acidity. In case No. 36 wherein the gall-bladder contents were a milky white in color and the cystic duct was completely closed, there was still free hydrochloric acid in the stomach. In cases No. 15, No. 29, and No. 35 where there was acidity; two, No. 29 and No. 35, showed a mild stenosis of the cystic duct and in No. 15 the stenosis was marked. Case No. 52 showed occlusion

TABLE I

Findings in Gastric Acidity in Twenty-four Cases of Cholelithiasis

Case No.	Age Sex	Pre-operative		Post-operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
1.....	60 M.	20	10					
5.....	30 F.	36	23					
19.....	25 F.	2	0					
43.....	71 M.	1	0					
58.....	63 M.	20	14					
4.....	46 F.	38	25			Marked	Dilated	Bac. coli. comm. Staphylococcus
10.....	41 M.	2	0			Marked	Vague	Bac. coli. comm.
15.....	45 F.	0	0			Marked (by stone)	Marked scarred stenosis	Bac. coli. comm. Bac. lactis Staph. aureus
21.....	46 F.	24	12			Marked (by stone)	Marked scarred stenosis	Bac. coli. comm.
26.....	47 F.	5	0			Marked (by stone)	Mild	Bac. coli. comm.
29.....	40 M.	0	0			Marked (by stone)	Mild	Bac. coli. comm. Staphylococcus
35.....	45 M.	0	0			Marked (by stone)	Marked stenosis	Bac. coli. comm. Staph. Strep.
36.....	59 M.	9	5			Complete (by scar)	Complete	Bac. coli. comm. Gall bladder sterile
51.....	67 M.	8	6			Marked (by stone)	Open	Bac. coli. comm. Bac. lactis Staphylococcus
52.....	51 M.	67	50			Almost complete	Open	Bac. coli. comm. Bac. lactis Strep.
11.....	46 F.	10	0	10	0	Mild	Open	Bac. coli. comm.
16.....	50 F.	8	0	3	0	Marked	Mild	Bac. coli. comm.
18.....	49 M.	2	0	0	0	Marked	Mild	Bac. coli. comm.
22.....	35 F.	28	10	16	0	Marked	Marked	Bac. coli. comm. Staphylococcus
28.....	40 F.	18	14	14	8	Mild	Open	Bac. coli. comm.
30.....	41 M.	10	0	0	0	Marked	Thickened dilated	Bac. coli. comm. Bac. lactis
31.....	39 M.	8	6	0	0	Marked	Open	Bac. coli. comm. Bac. lactis Staph.
47.....	48 F.	37	13	13	10	Mild	Open	Bac. coli. comm. Bac. lactis
53.....	62 M.	7	0	0	0	Mild	Open	Bac. coli. comm.

TABLE II

Findings in Gastric Acidity in Twenty-four Cases of Cholecystitis, Two of Tumor of the Liver One of Carcinoma of the Gall-bladder and One of Liver Abscess

Case No.	Age Sex	Pre-operative		Post-operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
13	74 M.	2	0					
14	50 F.							
27	61 F.	6	0					
37	43 F.	22	10					
12	27 F.	26	20			Scarred thickening	Scarred stenosis	Bac. coli. comm.
2	50 F.	0	0			None	Mild	Bac. coli. comm.
3	57 M.	0	0			None	Mild	Bac. coli. comm.
6	26 F.	18	4			None	Mild	Bac. coli. comm.
8	53 M.	30	20			Dilated	Mild	Bac. coli. comm.
9	18 M.	44	32			None	Mild	Bac. coli. comm.
20	32 M.	7	3			Dilated	Marked	Sterile
45	20 F.	4	0			Dilated	Marked	Sterile
50	33 M.	16	8			None	None	Bac. coli. comm.
55	44 M.	20	18			None	None	Bac. coli. comm. Staphylococcus
56	45 M.	82	34			None	None	Bac. coli. comm. Staphylococcus
7	34 F.	2	0	2	0	None	Mild	Bac. coli. comm.
32	41 F.	6	5	6	2	None	Mild	
39	56 M.	8	2	4	0	Dilated	Mild stenosis and thickening	Bac. coli. comm. Staphylococcus
41	45 F.	2	0	20	11	None	Mild	Sterile
48	38 M.	30	0	2	0	Dilated	Mild	Sterile
57	54 F.	26	0	26	15	Dilated	None	Bac. coli. comm. Bac. lactis
22	67 M.	35	20	12	0	None	Marked	Bac. coli. comm.
38	44 M.	29	24	46	22	Dilated	Marked	Bac. coli. comm.
46	29 M.	18	7	35	20	Thickened	Moderate	Bac. coli. comm. Bac. lactis Streptococcus

TABLE II—*Continued*

Case No.	Age Sex	Pre-operative		Post-operative		Degree of Obstruction		Bacteria in Bile
		Total Acid	Free Acid	Total Acid	Free Acid	Common Duct	Cystic Duct	
54.....	50 M.	9	7	0	0	Thickened	Mild	Bac. coli. comm. Diplococcus Streptococcus
49.....	52 M.	24	4	4	0	Dilated	Almost complete	Bac. coli. comm.
60.....	44 F.	3	0	32	16	Dilated	None	Bac. coli. comm.
63.....	42 F.	14	8	6	3	Dilated	Marked (kinked)	Bac. coli. comm.

of the common duct with marked atrophy of the gall-bladder which was continuous with a biliary fistula, yet in this case there was hyperacidity.

The above facts do not agree with those of Hohlweg and others. The interference with passage through the common duct, due to stone formation, regardless of whether or not there is stenosis of the cystic duct, limits in greater or lesser degree the gall-bladder function. According to our investigation, the function of the gall-bladder becomes disturbed due to inflammation, whether or not there is stone formation or stenosis, and one must also recognize the fact that the gall-bladder mucosa heals with difficulty once it has become inflamed, so that the gall-bladder function in cases of cholelithiasis is practically always greatly impaired or destroyed. Therefore, when the findings in gastric acidity vary so, as described above, then it is impossible to explain them only on the basis of functional disturbance of the gall-bladder.

When one considers the relation between hypoacidity in this biliary disease and the sex of the patient one finds, according to Rydgaard, 73 per cent. in men, 42 per cent. in women. Hypoacidity, then, is found more in men than in women, but according to Dangschaft, there is 50 per cent. in men and 76 per cent. in women. Our results are as follows: In twenty-seven male patients there were three with normal acidity, seven with hypoacidity, and twelve with anacidity. Thus giving a percentage of 81.5 of hypoacidity or anacidity in men as against 86.3 per cent. in women. From which one may see that the percentage is higher than that referred to above and that there is no appreciable difference between the sexes as regards the changes in gastric acidity.

In regard to age, as seen in the second table, hypoacidity and anacidity are found in every decade, but more between the ages of thirty and fifty; however, it might be a coincidental finding that in our series of cases these ages predominate. In our material we can say that the frequency of hypoacidity and anacidity does not increase with age, that is, that there is no senile achylia, but a definite relation to cholelithiasis. In short, it is unlikely to

determine any relationship between hypoacidity or anacidity and sex or age in the patients.

Age

Gastric Acidity	Up to 20	21 to 30	31 to 40	41 to 50	51 to 60	More than 60
Hyperacidity	1	0	0	0	1	0
Normal Acidity	0	2	0	3	1	1
Hypoacidity	0	2	4	6	4	2
Anacidity	1	0	3	11	2	3

Within the limits of thirty to fifty, the sex difference was not perceptibly great, being only slightly greater in women. These findings correspond to the fact that cholelithiasis occurs more often in women than in men and is much more frequent between the ages of thirty and fifty.

In the investigation of the functional changes of the liver in cholelithiasis, which will be described later, we made bacteriological examinations of the bile which was withdrawn from the gall-bladder or the common duct at operation. These tests were carried out on forty cases. In four of these, the cultures were negative (cases Nos. 20, 41, 45 and 48). The others showed simple infections with bacterium coli, or mixed infections of diplococci, staphylococci, streptococci, or of bacillus lactis acidi with bacterium coli.

In cholelithiasis there is almost always infection of the bile with bacterium coli, as has already been shown by Miyake (1913), Yokota (1926), Fuld (1927), and others. In our cases, the degree of hypoacidity paralleled the degree of infection. The five exceptions to this were the three cases (No. 41, No. 45, and No. 48) which showed no infection and anacidity, and one case (No. 20) which showed hypoacidity and no infection, and a fifth case (No. 52) which showed hyperacidity and a very low grade infection. The degree of infection, however, seems to have no relation as to whether it is a single or a mixed type of bile infection. Correspondingly, in the cases of anacidity the degree of infection is usually most marked. Hypoacidity or anacidity associated with stone in the common duct, which nearly always showed a high degree of bile infection, was usually more marked than the hypoacidity found in cholecystitis.

In investigations done on bile removed from apparently healthy gall-bladders at autopsy by Fraenkel and Krause, Williams and Windsor, and Kirose, bacteria were often found. Opposed to this are the fifteen cases reported by Mieckowski (1900) and the thirty-five cases of Toida (1920) and our five cases in which the bile removed during a laparotomy for some other condition, was found to be sterile. The assertion of van der Reis that bacterium coli communis, (Gram-negative) which is found in abundance in the colon, shows a tendency gradually to disappear in the upper small intestine where non-pathogenic bacteria, (Gram positive) the so-called enterococci, are found in profusion and that not infrequently the upper part of the

duodenum has been found free of bacilli, has lately been corroborated by Bitter and Loehr, following investigations of many patients suffering with diseases of the stomach and duodenum. They went still further and asserted on the basis of different clinical observations that the reason for this lay in the acid secretion of the stomach. According to them, the gastric acidity has an antiseptic influence upon the first part of the small intestine as well as the stomach and, to be sure, the pathogenic bacilli coming down through the œsophagus, are destroyed by the bacteria coming up from the lower gastro-intestinal tract. If, therefore, the stomach acid possesses its usual properties, the stomach and first part of the small intestine become poor in bacteria and especially free from bacterium coli. When, on the other hand, hypoacidity or anacidity is found, conditions are very favorable for the entrance of bacteria from the lower gastro-intestinal tract up into the stomach.

As we have shown above, in cholelithiasis there is nearly always hypoacidity or anacidity and there is also bacillary infection, especially with bacterium coli, the degree of which depends upon the degree of hypoacidity. Bitter and Loehr state that the bacteria enter the stomach from the intestine mainly due to the hypoacidity and anacidity. There is, however, the prevalent view that the cholelithiasis is the primary condition, that the hypoacidity is secondary, because in cholelithiasis the hypoacidity and anacidity accompany the bacterial infection. The basis for this view is in the post-operative results and in animal experimentation, wherein it is found that hypoacidity and anacidity appear after cholecystectomy. Others claim that this drop in gastric acidity does not obtain following operation. Of the patients operated upon by us for cholelithiasis or cholecystitis, twenty-two were afterwards examined, of whom thirteen had anacidity, five had hypoacidity and four showed normal acidity. If these results are compared with those obtained before operation, wherein ten had anacidity, ten hypoacidity, and two normal acidity, one sees that following operation hypoacidity or anacidity is more frequent.

	After Operation
Anacidity before operation, 10-cases	7 cases had anacidity 1 case had hypoacidity 2 cases had normal acidity
Hypoacidity before operation, 10-cases	5 cases had anacidity 4 cases had hypoacidity 1 case had normal acidity
Normal acidity before operation, 2 cases	1 case had anacidity 1 case had normal acidity

Referring again to Table I; seven out of thirteen cases showed anacidity before operation, one case was normal, and the other five showed hypoacidity. In these last five cases (22, 31, 39, 49, 54) the anacidity before operation was significantly low and after operation there was an absence of acid. In the two cases, numbers 28 and 48, where the pre-operative hypoacidity was not marked and, hence, approached a normal acidity, there was

after operation, only a slight drop, 8 or 10 degrees. Patient No. 38 had normal acidity before and after operation. Three cases, numbers 41, 57 and 60, which showed anacidity before operation and another case (46) of pre-operative hypoacidity, showed an increased post-operative acid secretion which returned to hypoacidity or normal acidity. Only one case, number 23, changed from a normal acidity before operation to anacidity after operation. In addition to this we have noticed that one patient, number 22, who had anacidity before and after operation, three years later showed a normal gastric acidity. According to the assertion of Toida there were ten of his cases who showed an increased acid content post-operatively and five cases in whom the acidity decreased. Matsuo in nine cholecystectomies showed five patients with post-operative increase and four cases with post-operative decrease in acidity.

Aldor, Ohly, Toida, and others attempted to explain this hypoacidity on the basis of a chronic gastritis. Although differing in some respects, they agree essentially that chronic gastritis accompanies cholelithiasis, but we do not know how they interpret the relation between the bacteria and the cholelithiasis. We believe that hypoacidity and anacidity in cholelithiasis is brought about by some condition which may exist before the patient is actually ill, in which condition the bacteria easily enter the duodenum and stomach, whence they infect the bile passages. When cholecystitis and cholelithiasis are finally brought about by these infections, the hypoacidity is increased by factors which influence gastric secretions, such as fever, chills, vomiting, etc. Following this the penetration by the bacteria is facilitated and gastritis chronica anacida follows. From our clinical observations of patients with cholelithiasis we have noticed in a very careful history that long before the actual illness, the patient complained of symptoms of chronic gastritis, therefore, we believe that the factors such as hypoacidity, anacidity, bacterial infection and cholelithiasis are in direct relation to one another, that they affect the gastric mucosa and in this way aggravate the clinical condition. Hence, in this disease the estimation of gastric acidity should take its place with the other methods of clinical examination.

CONCLUSIONS.

1. In cholelithiasis or cholecystitis there is nearly always hypoacidity or anacidity. In our cases the percentage of hypoacidity was 77. With a stone in the common duct the acidity is lower than in cholecystitis and there is more anacidity than in the latter condition.

2. From the post-operative results in our cases we cannot see that hypoacidity or anacidity has any direct relation to the changes in the gall-bladder or cystic duct or any disturbance in their function; especially after operation there is no significant change, wherein we cannot agree with the assertions of Hohlweg and Schmidt.

3. The gastric acidity in cholelithiasis seems to be the result of bacterial infection of the bile. We believe that the decrease in acid was present

before the occurrence of gall-stones and so favored the ascent of the bacteria up the intestinal canal giving opportunity for biliary duct infection. As soon as this infection accompanied the cholecystitis and cholelithiasis there was a further deficiency in acid, due to such factors as fever, chills, vomiting, etc., which influence the gastric secretion, which increased in severity and finally led to gastritis chronica anacida. Therefore, we cannot agree with the assertion that cholelithiasis is primary and the hypoacidity or anacidity secondary. We hold to the view that after the inception of cholecystitis and cholelithiasis, hypoacidity or anacidity and bacterial infection, which stand in close relation to the two above mentioned conditions, favor the progress of these diseases.

4. The measurement of gastric acidity in cholecystitis and cholelithiasis is an important diagnostic method and also serves as a means for judging the extent of the disease.

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SURGERY IN BREAST TUMORS; PROBLEMS CONCERNING DIAGNOSIS AND TREATMENT *

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This subject was selected for the Annual Oration because many of the Fellows of the Philadelphia Academy of Surgery have done much to increase our knowledge, improve our technic and enhance the results in breast surgery. In fact every member except those who are directing their efforts to keep us on our feet, those who endeavor to clear our minds and stabilize our bodies, those who remove obstruction from our excretory channels and, at least one, who keeps our jaws in motion, are interested in, but discouraged with, surgery in malignant breast tumors. It was expected that by collecting a fairly large group of cases of "tumors" of the breast from two well-established hospitals something could be learned that would be of assistance in making early and correct diagnoses and secure better results. Follow-up systems in these institutions have not been established sufficiently long to be of material value. The records also leave much to be desired. The operations were done by thirty-five surgeons, and many of the patients were private which may account for the omission of some desirable information in the hospital histories.

The laboratory work, with the exception of a few brief intervals, was done by excellent men. Opinions on tissue diagnosis were often obtained from other sources. Not infrequently the pathologists did not agree. Again, the same slides examined by different men in the same laboratory would differ in the diagnosis, or the report would be so worded that a surgeon with a moderate knowledge of pathological histology might suspect totally different tumors.

In May of 1924, the writer [12] operated upon a woman for simultaneous bilateral mammary cancer. The patient was presented February 10, 1926, at a joint meeting with the New York Surgical Society, an account of which appeared under the Transactions of the Academy of Surgery, May, 1926. The breasts were removed by the Stewart technic at a twelve-day interval. One was examined by the director of the hospital laboratory, the other by an assistant. There was sufficient dissimilarity in the reports to make one suspect unlike carcinomas, whereupon the director was requested to examine both specimens. He reported them as being identical, both adenocarcinoma suggestive of duct origin. The axillary nodes were not involved. She wrote that she was in splendid health on May 2, 1929.

Quoting from Bland-Sutton [26] "the breast is so open to observation that

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it is the organ from which the knowledge of the natural history of cancer was primarily derived." In regard to this Rindfleisch pertinently remarks: "The tumors of the female mammary gland have been so often, and already at so early a period, the subject of earnest histological investigation, that in this we might not improperly call the mammary gland the nurse of pathological histology." One would think that the pathology of the breast could be so simplified that errors in histological diagnosis should not occur. We owe much to McFarland [15] who has endeavored to remove the haze from the nomenclature of some of the benign breast tumors. In an effort to study the more common fibro-epithelial tumors, to observe the differences between adenofibromata and fibro-adenomata he assembled from five large hospitals about 300 tissues that had been indexed under thirty-three different names. Some of these were not tumors at all. To read his conclusions will stimulate one to read his paper:

"1. Two hundred and eighty-nine cases, supposed to be benign fibro-epithelial tumors of the female breast, were studied clinically and pathologically, for the purpose of harmonizing and simplifying the nomenclature.

"2. One hundred and five of them, described under no less than thirty-three different names, were found to be periductal fibromata.

"3. One hundred and forty-seven, described under much the same names, showed no histological indication of being tumors, or in any way related to them, but were simply mammary gland tissue, either normal, or in some condition of involution.

"4. A system of nomenclature that permits tumors and non-tumors to be given the same names is too faulty to be continued.

"5. As all of the tumors resolved themselves into varieties of a single well-characterized genus, it would be well to call them all by the same name, and that recommended as most appropriate is Warren's choice, periductal fibroma.

"6. In all but seven cases there was no difficulty in separating the tumors from the non-tumors.

"7. The research having been conducted upon material collected from five large, first-class hospitals, where it had been studied by many different pathologists, may be regarded as fairly representative of pathological tissue work as commonly conducted in hospitals.

"8. The mistake of calling non-tumor tissues by names belonging to tumors, may have been the result of overzealousness on the part of the pathologists to coöperate amicably with the surgeons.

"9. There are anatomical and physiological mammary disturbances of the breast that may occasion 'lumps' that have no relation to tumors, and the surgeons should be informed, and not led to believe that they have removed tumors when none existed.

"10. Pathology must remain confused both in theory and application unless its terminology be so relieved of ambiguity as to be easily understood."

It has been clearly demonstrated by Cheatle,[3] Fraser,[7] Wainwright,[16]

and others, that sections cut from the whole breast are less likely to lead to error in diagnosis than if a small section of the tumor be examined. Sectioning whole breasts undoubtedly will aid pathologists to correct former and present misconceptions as to benign and malignant lesions. Several recent papers by Cheatle [3] definitely indicate the term "chronic mastitis" a misnomer. He states that nodularity and lumpiness often palpated anteriorly in breasts of women between the ages of thirty and forty-five, and especially after lactation, being due to the thickening of the ligamenta suspensoria of Sir Astley Cooper which are attached to the skin. The branches contain lobules of fat. If the skin is undercut, the cutaneous attachments divided, the nodularity will disappear. Unfortunately an early carcinoma may be masked by this condition.

Nearly all papers dealing with carcinoma of the breast stress early diagnosis. Teachers of surgery and textbooks on surgery must inform students and doctors how a diagnosis of early malignancy is made, if it can be done. When the röntgenologist fails to detect an early lesion of the stomach or bowel, and he often does, the surgeon will criticize him. Finally, when the patient vomits blood or has an obstruction there may be a re-check and the surgeon will blame the röntgenologist for losing an operable, and perhaps a curable, case. The surgeon cannot lean on the X-ray department to diagnose a breast tumor. Textbooks contain photographs of carcinoma of the breast, showing the tumor which may be so large as to deform the gland, with retracted nipple, skin involvement, axillary node involvement, and statistics showing far and wide metastases. All of this is necessary and impressive. However, we should exert ourselves more to recognize the disease before it has reached the stage when chance for cure has been decidedly diminished.

Most carcinomas are discovered inadvertently by finding a lump. There are other symptoms which should be observed by all persons. At puberty and often at the menstrual period there may be pain or discomfort. Lancinating pain at one point which appears at irrespective times or differs in character from previous pain or discomfort is looked upon by Cheatle [6] as suspicious of carcinoma. The earliest case of carcinoma of the breast he operated upon had no other symptoms; there was no demonstrable lump, microscopy revealed a focus of carcinoma which had begun to invade the surrounding fat. A discharge of blood or serum should also be looked upon with suspicion. Localized nodularity, or a definite hard lump in the gland, probably will continue to be our chief diagnostic symptom.

Carcinoma mastitoides, or carcinoma of the lactating breast, very likely is the most malignant, fortunately infrequent, tumor of the breast. The majority of these tumors are diagnosed abscess. A professor, not of surgery, but one who operated when the opportunity presented itself, made four long radiating incisions, practically cutting the breast into quarters, for carcinoma mastitoides in late pregnancy. The woman did not live to see her child born. General practitioners and obstetricians particularly should keep the picture

of this lesion in mind. Inflammatory carcinoma of the breast reported by Burton J. Lee [14] and Tannebaum probably differs from lactation carcinoma. In a list of twenty-eight cases, fourteen had never lactated. The clinical phenomena are similar. None of these cases occurred during pregnancy or lactation. To diagnose carcinoma mastitoides we quote from a previous paper. "The [11] disease is seen during the childbearing period (sometimes in the latter months of pregnancy, but more often in the early months of nursing), prior to forty years of age, and at the height of physiological activity. It begins as a localized area of induration, which extends rapidly and soon involves the entire breast. The localized 'stony-hard' nodule is conspicuously absent. The skin early assumes a dusky red or purplish-red color. It becomes brawny, feels hot, of the 'pigskin' variety, is fairly well marginated, and appears to be attached to the underlying structures. The previously pendulous breast is firm, increases rapidly in size, and projects like that of a virgin. Pain is not so severe as one would suppose from the appearance of the breast. There is no fluctuation, and but moderate tenderness. The nipple shows no retraction in early stages. The axillary glands may or may not be palpable. The involved skin not infrequently extends well beyond the breast, and the other breast may become involved early. In fact, several cases of simultaneous invasion have been reported.

"The onset in suppurative mastitis is acute, pain often is intense, and tenderness is marked. The skin is bright red and becomes dusky as inflammation progresses. It is never brawny, and fluctuation usually can be determined. There is definite elevation in temperature and leucocytosis. The differential count nearly always shows an increase in the polynuclear cells. In carcinoma, the temperature is normal or slightly elevated. The leucocytes may be slightly increased, and the differential count frequently shows an increase in the mononuclear cells. The diagnosis should be made without section for histological study as has been suggested."

In a paper recommending exploratory incisions in cancer of the breast Fitzwilliams [7] says this about early cancer of the breast: "There is not a single sign of malignancy and nothing even to bring malignancy to mind. There is an indefinite something and undefined thickening. Diagnosed in this stage is the only time we can almost guarantee a cure to a patient." Anything having the characteristics of malignancy he does not consider as early carcinoma. All the signs and symptoms of cancer of the breast are due to extension of growth. This must occur.

From published statistics it is estimated that 80 per cent. of breast tumors are malignant, 20 per cent. are innocent. If one compares recent statistics with those of the past twenty-five years it will be noted that the number of innocent tumors coming to operation have increased in ratio with the malignant tumors. Gibbon's [9] analysis of his last two hundred cases showed that 45 per cent. were benign. Approximately 38 per cent. of the cases collected from the records at the Pennsylvania Hospital since 1901 were benign, and 46 per cent. of those from the Jefferson Hospital since June, 1920. The latter

corresponding with Gibbon's cases. Apparently more attention has been given in recent years to benign growths. If this is true an occasional early carcinoma should be found. We can no longer say that the chances of a breast tumor being malignant are three to one.

Exploratory submammary incision with excision of the suspected tumor should be done in all doubtful cases. This can be accomplished satisfactorily and safely with the endotherm knife. The writer has had no experience with frozen section reports. He prefers to rely on macroscopic evidence. Should there still be uncertainty about the diagnosis the wound can be closed in the proper manner and wait for a fixed specimen report. Seldom will the operator have his opinion reversed by the pathologist.

Attempts have been made to grade the degree of malignancy in carcinoma; histologically by Broders, Greenough and others, and clinically by Lee [13] and Stubenbord. Histological grading is of no value to the surgeon before or during the operation. Lee and Stubenbord use the age, lactation, rate of growth and extent of disease as weighting factors, subdividing each factor into gradation factors, apparently with a considerable degree of accuracy. All surgeons have considered the weighting factors without any mathematical values. One should add obesity and heritage. There is sufficient evidence that a person with a bad familial history of carcinoma must ofttimes be placed in the group of bad prognosis. The fact remains that a benign growth requires excision and a malignant growth the most thorough operation the surgeon is capable of performing.

There are numerous well-standardized operations for amputation of the breast. A surgeon should do the operation he likes best if it permits of wide excision of fascia as advocated by Handly. We believe in removal of the pectorals with few exceptions. The transverse elliptical incision of Stewart has met our requirements in all but two cases. A recent case—a large fibroma in the upper hemisphere, regarded clinically as a fibrosarcoma. The other a large, slow-growing, fixed carcinoma extending high toward the shoulder. In both of these the incision was oblique extending toward the axilla. It has been our custom to undermine the lower flap well over the rectus abdominalis, incise the fascia and dissect it upward toward the breast. Then the upper flap is reflected, and the axilla cleaned out. It is desirable to have an X-ray of the chest before operating for malignancy.

Pre-operative X-ray treatment according to Wood has little to recommend it. Experiments in animals have shown that the lymphatics cannot, but terminal arterioles can, be closed by the X-ray. Therefore, to use X-ray preliminary to operation on the assumption that it will make operation safer by closing the lymphatics is wrong if we believe in the spread of cancer by the permeation method. On the other hand, if we accept the embolic theory it may be of value. That metastasis does occur through emboli in the vascular system seems plausible. We have noticed infection more often where X-ray was employed pre-operatively.

Since the routine post-operative X-ray treatments there have been de-

cidedly less local recurrences in our cases. Local recurrences seem to respond fairly well to the X-rays. We believe in excising these when it is feasible—in the absence of metastasis and a limited number of tumors.

Concerning reëxcision of recurrent tumors it may be of interest to recall a case of S. D. Gross [10] reported in his "System of Surgery" published in 1864. An unmarried woman, aged forty-four, had a partial excision of the left breast for a soft tumor in 1857. In 1859 she came under the care of Doctor Gross when he removed the entire breast. In September, 1861, he performed the twenty-third and last operation. Altogether fifty-four tumors were removed. Recurrences were at or near the former cicatrix, usually within a few weeks. The sixth tumor removed was examined microscopically by Doctor Packard and diagnosed encephaloid of the mamma. She was well three years after the last operation. We have on two occasions excised recurrent tumors.

Statistics are fallacious because of the discrepancies of histological reports and different methods used in assembling cases. Ashhurst [1] properly states that when a large clinic reports statistics on carcinoma a table should be used which is comparable to the scheme employed by Greenough and Simmons. Their five-year cures thus presented 1918–1920. This we consider a fair average. As stated before, we are not prepared to give a correct estimate of our five-year cures. Our personal records are also lacking in this respect. The private patients average 34 per cent. of five-year cures. Ward patients fall far below this figure.

Greenough's statistics show marked improvement as time went on. Technic has been improved since 1894. Have the results been commensurate with the technic?

Let us compare the results of carcinoma of the colon of recent years with good technic for resection with those of carcinoma of the breast with good technic for radical amputation. It is obvious that the advance made in colon surgery has outshadowed the advance in breast surgery. Therefore, in order to obtain better end results it is evident that it cannot be accomplished by refined technic alone. The case records reviewed included the breast tumors at the Pennsylvania Hospital from 1901 to January, 1929. Very few were found prior to 1905. Approximately fifty cases concerning which there were either operating room records or laboratory reports, the histories could not be found. There were histories and laboratory reports of 450 tumors during that time of which 278 (62 per cent.) were malignant, in thirty-four of these the treatment was not stated or the operation was not described. There were 172 (38 per cent.) benign tumors.

The records at the Jefferson Hospital were collected from June, 1920, to January, 1929. There were 431 tumors; of these 234 (54 per cent.) were malignant of which twenty-four were not operated upon, and in five the treatment was not described. There were 197 (46 per cent.) benign tumors.

Total malignant tumors of both hospitals were 512, of these six were

sarcomas, a trifle more than 1 per cent. A recent textbook on surgery states that "sarcomas constitute about 10 per cent. of the tumors of the mammary gland."

The records of 881 tumors were examined, of this number 114 were personal cases. The laboratory reports of all of the latter were reviewed, 50 per cent. of these were malignant. The large proportion of the benign tumors of our personal cases we believe is due in a measure to the fact that nearly 70 per cent. were private. The Jefferson Hospital has proportionately a much larger private service than the Pennsylvania Hospital which may in part account for the higher percentage of benign tumors. Furthermore, we did not include cases from the Jefferson Hospital prior to 1920. It would seem that patients with suspected breast tumors are more likely to apply for advice. However, there is a fallacy to offset this somewhat. The average duration of malignant tumors in the cases at the Pennsylvania Hospital was 9.92 months; Jefferson Hospital 11.84 months.

It has been suggested by pathologists and surgeons that the pathological diagnosis of malignant tumors should be so worded that the surgeon and radiologist could recognize the type and virulency of the tumor. Certain types respond favorably to radiation.

In going over the pathological reports of our own cases it was interesting to note the description of these tumors. Those of vast experience would describe the specimen macroscopically and microscopically with accuracy and detail and frequently express an opinion whether or not it was very malignant, then simply put down the diagnosis "carcinoma." Often, however, no mention was made of the axillary glands. All specimens about which there was any doubt were sent to other pathologists for opinions. We believe that all of the pathological specimens were studied with interest and care and in very few cases would the diagnosis be changed if the slides were submitted to other pathologists. It would be highly desirable to have detailed description and uniform and simplified diagnoses.

That the pathologists should be supplied with more accurate data is obvious. MacFarland gave excellent reasons for careful notes.

Two cases, one not included in the cases reviewed, strongly suggest that "enucleation" of a supposedly benign tumor is insufficient. An able surgeon enucleated a benign tumor from a woman's breast forty-five years of age. A competent pathologist reported it as benign. Within twelve months there was a recurrence beneath the scar with metastasis. The breast tumor was excised for verification of the diagnosis: it was carcinoma.

The other case, a woman fifty years of age, had a fibroma excised and examined by a reliable pathologist who confirmed the diagnosis. Within six months there was a recurrence. Shortly the breast had the appearance of a rapidly-growing scirrhus. The first slides were examined by other pathologists and the diagnosis was confirmed. Following a radical amputation the tumor was examined which proved to be scirrhous carcinoma. These cases indicate that it is safer to excise the segment of the breast containing the

benign tumor. The carcinomatous cells probably were close to the innocent growth.

In two of our personal cases unnecessary radical amputation was done; one for diffuse cystic mastitis in which carcinoma was suspected; the other proved to be multiple fibromata which had been diagnosed clinically as fibrosarcoma. The pathologist, a young man, had the specimens examined by one of wide experience who said there was no evidence of malignancy. They both suggested that we follow the case carefully.

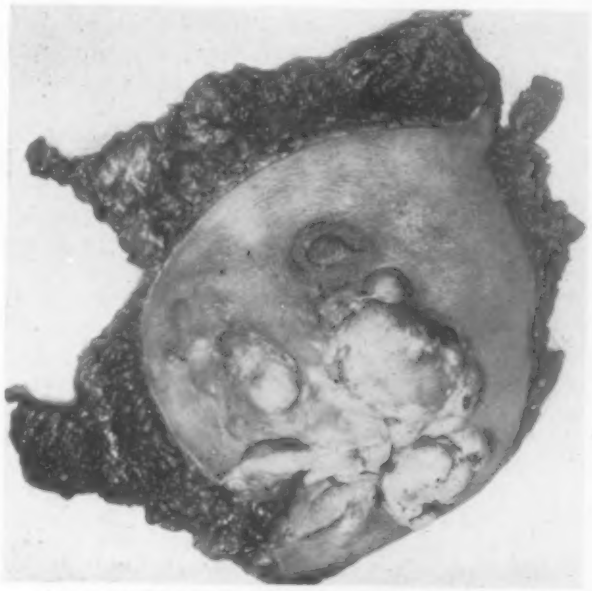

Fig. 1.—Multiple fibromata. Diagnosed clinically as fibrosarcoma. Radical operation May 11, 1928. Well July 15, 1928.

On one occasion we erred by excising a growth believing it to be benign but on incision it appeared to be malignant. The laboratory reported it scirrhous carcinoma. The patient was operated upon for a mixed tumor of the parotid gland. As she came to the operating room our attention was called to the breast tumor. A hurried examination was made and it was thought to be a benign tumor. The patient was told later that the tumor was malignant and amputation was advised. She declined. X-ray treatments were given. There has been no recurrence in seven years. Of the fifty-seven personal cases, fifteen were diagnosed pathologically mastitis. Probably some of these were operated upon unnecessarily. Again, several diagnosed clinically mastitis were reported cystadenoma.

My thanks are due to the staffs of both hospitals for permitting us to examine the records, and especially to Dr. Alan Parker who gathered the data.

CONCLUSIONS

1. Recent records indicate that more benign breasts are operated upon than formerly. This should lessen the incidence of carcinoma.

2. Pathologists should endeavor to standardize and simplify the nomenclature of benign and malignant breast tumors. Special training is desirable.

3. Suspected benign tumors should not be enucleated but the section containing the tumor should be excised.

4. Amputation of the breast leaves a bad deformity. Let us reserve the operation for definite indications and then do it thoroughly.

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TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD APRIL 1, 1929

The President, Dr. Astley P. C. Ashhurst, in the Chair
Calvin M. Smyth, Jr., M.D., Recorder

MULTIPLE MYELOMA

Dr. J. Stewart Rodman reported the case history of a colored woman, thirty-three years of age, who was admitted November 1, 1928, into the reporter's service, at the Woman's College Hospital, with the chief complaint of pain in the hips, back and shoulders and a tumor about the size of an adult patella three inches below the left knee-joint on the anterior surface of the right tibia. Eight years before, she struck the left leg, at the site of the present tumor, against a tree. No break of the skin and no fracture resulted but the leg was painful and a small hard nodule developed about one month later. It had never been painful but has continued to grow until it became about three times its original size when she was admitted to the hospital. For the past four years she had complained of the present symptoms. Due to pain she has been unable to walk without crutches for the past three months and when she does so there is now pain in the sternum, ribs and shoulder. She has had severe pain in the left thigh for the past three weeks and has been treated for rheumatism for a year.

The physical findings of importance were the presence of the tumor of the left leg three inches below the knee-joint. This tumor was about one and a half inches in length and one inch in width; slightly movable over the bone and apparently growing in the subcutaneous tissue. It was hard in consistency. There was enlargement of the inguinal glands on both sides. On the right, small nodular bodies extend subcutaneously down the inner side of the thigh to the inner side of the knee. There is tenderness on deep palpation on the inner side of the right thigh just below inguinal region. On the left side there is extreme tenderness just below Poupart's ligament and a second area of tenderness on the outer side at a little more distal level. There is pain at the left hip-joint on passive motion. On two occasions the blood Wassermann was reported as anticomplementary. The blood count was: hæmoglobin 60 per cent.; erythrocytes 4,044,000 leucocytes 4100. Blood chemistry showed calcium, CO_2 combining power, sugar, and urea to be within normal limits. Icterus index 3.6 van der Berg negative direct. The urine was essentially negative.

On the X-ray diagnosis of probable multiple myeloma the urine was examined for Bence-Jones albumosuria and found positive. On November 16, 1928, the tumor of the left leg was removed under gas-oxygen anæsthesia. It proved to be unattached to the bone and the pathological diagnosis was myxofibroma. The patient was discharged December 13, 1928, at her own request.

METASTASIS TO BONE FROM CARCINOMA OF BREAST

Dr. J. Stewart Rodman reported the case of a married woman, fifty-five years of age, who was admitted May 10, 1928, into the reporter's service

at the Woman's College Hospital. This patient had known of a tumor in her left breast for five years, at the beginning of which time she noticed a small red area in the outer upper quadrant. About one year ago, the mass having increased three or four times its original size, the skin broke down and it began to bleed. Still for some months she continued to treat herself until finally in April, 1928, she consulted Dr. George Pfahler. Since then she had had fourteen X-ray treatments. The bleeding stopped and the mass grew smaller in size. She was then referred to Doctor Rodman for operation.

The left breast presented an area, 5 by 2.5 centimetres, to the outer side of the nipple in the upper outer quadrant, the skin over which was ulcerated. There was a definite tumor mass beneath, which was not adherent to the chest wall. The axillary glands were palpable on the left side.

May 11, 1928, the breast was amputated with no other idea than the control of hæmorrhage and the removal of the ulceration. Pathological examination diagnosed the mass adenocarcinoma.

March 14, 1929, about ten months after her first admission to the hospital she was readmitted for the purpose of X-ray study because she complained of a lump in the right clavicle and pain in back for five weeks. Since her operation she had gained weight and her general health was greatly improved for about seven months, when she first noticed the lump above referred to in the right clavicle.

Dr. Jacob Vastine demonstrated a series of X-ray films illustrating various phases of the metastasis to bone from carcinoma of breast. The speaker also called attention to some of the results which had been obtained from the treatment of primary growths by intensive radiation. He laid particular emphasis on the fact that most cases which the röntgenologists were called upon to treat were already in an almost hopeless condition. Doctor Vastine was of the opinion that primary growths could be treated with practically the same degree of success by radiation as by surgery, if the röntgenologists had the opportunity of treating the favorable ones.

CHORDOTOMY FOR GASTRIC CRISES, COMPLICATED BY ACUTE INTESTINAL OBSTRUCTION

Dr. Hubley R. Owen and Dr. Temple Fay, by invitation, reported the following case which the reporters believe to be the first one reported in which an acute intestinal obstruction occurred in a case where section of the anterolateral columns (chordotomy) had been performed, rendering the patient anæsthetic to pain on the right half of the body below the nipple line. The signs and symptoms of intestinal obstruction in the presence of this anæsthesia were unusual. An exploratory laparotomy was possible on the right side without the need of anæsthesia, and an opportunity was afforded to observe the remaining distribution of pain fibres to the peritoneum, a fact of much importance, neurologically. The case also illustrates a new method of chordotomy whereby the selection of pain fibres within the cord itself, under local anæsthesia, is possible, so as to permit the destruction of these fibres alone, leaving other forms of sensation intact.

Doctor Owen established at the time of his operation, the fact that the parietal peritoneum on the right side was insensitive to pain. This corresponded to the area of the pain loss also noted in the skin and muscle layers. Doctor Owen found that traction or manipulation of the visceral peritoneum

was painful, indicating clearly that the pain fibres remained in the visceral peritoneum, and either had their origin from the left side, or entered the visceral pertioneum from a level above the sixth thoracic segment of the cord on the right.

The operation of chordotomy was suggested by Doctor Spiller in 1907, and was first carried out on the human being for him by Doctor Edward Martin, in 1911. Since that time it has been used frequently in this country and abroad as a means for relief of pain. The development of a safe and accurate technic for this procedure is due to Doctor Frazier, who reported a series of these cases with Doctor Spiller, in 1920. The method used by Doctor Frazier was the introduction of a small curved hook, designed by him to include only the anterolateral columns of the spinal cord. This method has given extremely satisfactory results. Doctor Spiller has suggested a further refinement in technic, when indicating the possibility of separating the pain and temperature fibres within this anterolateral column, by the introduction of a small knife to the desired depth, while the patient is under local anæsthesia, and the neurologist is present to determine the exact level of anæsthesia for pain or temperature required in the operative procedure.

It has been possible in two cases so far, to dissociate the pain and temperature fibres and to establish exactly the level of anæsthesia desired. The following case illustrates this method of chordotomy and the location of the fibres supplying the lower extremities and the trunk. A further addition to the understanding of pain distribution to the visceral peritoneum is due to the subsequent observations of Doctor Owen at the time of his operation for intestinal obstruction.

The patient was studied in the neurological service of Dr. Edward Strecker, at the Jefferson Hospital, where a diagnosis of tabes associated with gastric crisis was made. Later she was transferred to the Philadelphia General Hospital for continued treatment and observation, where she was under the charge of Dr. George Wilson who recommended section of the anterolateral columns for relief of the severe pains, associated with her crises. A bilateral chordotomy was performed at the fifth thoracic segment of the cord following which she was pain free for one month, until the sudden onset of the intestinal obstruction.

Present Illness.—Two years before admission the patient began to complain of shooting pains in the sides and epigastrium which were bilateral, extending around to the back. Nausea and vomiting usually followed these attacks of pain. The pain always radiated around the body. There was belching of gas, abdominal distention, precordial distress, rapid respirations with marked palpitation. She complained of this pain for several months before she went to see a physician, who advised an operation after examining her. She was operated at the Lankenau Hospital one year ago, for gall-bladder disease and made an uneventful recovery, but had recurrence of her former abdominal pains about three months after the operation. The attacks of pain have become more frequent recently, nausea and vomiting accompanying the attack. There was loss of appetite following these attacks; food did not bring on an attack, but often made the pain worse during the period of her pain. She had lost twenty pounds which she ascribed to her inability to assimilate

food. Her menses aggravated the attacks. There was no reference of pain to the arms or groin at this time. The pains of which she complained are similar to those which began five years ago, and were called rheumatic pains. The attacks of pain have increased to such a degree that she spends most of her time in bed.

She was a fairly well-nourished, white female, who evidently was in severe distress and pain, as evidenced by her position and facies.

Neurological examination showed marked diminution of the deep tendon reflexes throughout, with Argyll-Robertson pupils and ataxia.

Gastro-intestinal X-ray.—Ileitis and cæcitis of infectious origin. No X-ray evidence of intra-abdominal malignancy. Intra-abdominal adhesions, post-operative.

The patient was diagnosed as having tabes with gastric crises. In consultation with Doctor Gilpin it was decided to place her on treatment of spinal drainage and mercury by inunction. She had three drainages and made excellent progress, having had two attacks of epigastric pain up to November 18, 1928. On that date, she complained of pain in the same place. No therapy seemed to be of benefit. November 20, she became confused and very delirious, shouting and talking about committing suicide. Although she was confined to a quiet room, she disturbed the entire ward. It was decided therefore to transfer her to the Philadelphia General Hospital which was done December 3, 1928.

Wassermann studies at the Philadelphia General Hospital showed a four plus spinal Wassermann. Several blood Wassermanns were negative. The patient was studied in the service of Dr. George Wilson who concurred in the diagnosis of tabes with gastric crises, and because of the patient's severe and prolonged attacks of pain, advised section of the anterolateral columns on each side of the spinal cord as a means of relief of pain. She was transferred to the service of Dr. Temple Fay, on January 21, 1929, and a bilateral chordotomy performed under local anæsthesia.

The anterolateral columns were incised on the left side by means of a cataract knife. The resultant sensory pain and temperature loss wass demonstrated after each incision by careful neurological tests made by Doctors Spiller and Wilson, until the level for pain loss was demonstrated as high as the fourth thoracic segment on the right.

Following the left-sided chordotomy there was some loss of motor power in the left leg. The dentate ligament on the right was then incised, the cord rotated and chordotomy performed. Anæsthesia was not demonstrated as high on this side, but only to the region of the hip. On the right side of the body, anæsthesia was demonstrated approximately to the third dorsal segment.

The patient had an uneventful post-operative convalescence excepting for some lighting up of an old cystitis. She rapidly regained the power in her left lower extremity and anæsthesia was demonstrated for pain on the right side as high as the fifth thoracic segment; a diminution for temperature sense was present though this was not lost. On the left side, the loss of pain extended as high as the second lumbar segment, with marked impairment of pain as high as the ninth thoracic segment. Temperature sense was also impaired, but not lost in this area. (Fig. 1.)

The case demonstrated that the pain fibres for the sacral region and lower extremities are situated on the periphery of the spinal cord. Doctor Spiller's sensory examination disclosed that the area of anæsthesia rose on the body as the knife was introduced successively deeper into the cord in the region of the anterolateral columns. The definite loss of pain without a similar degree of temperature loss indicates that these fibres are represented by separate pathways within the spinal cord, and that with great care, under local anæs-

thesia, it might be possible to select the exact fibres desired and regulate the height of anæsthesia for pain required, in this operation. The former method was one in which under general anæsthesia the entire anterolateral column was enclosed within a hook and sectioned *en block*. The patient was pain free and had made a most satisfactory recovery until February 18, 1929, approximately one month after her chordotomy, when she was awakened by severe pain in the right pectoral region, which radiated down *to the right elbow*. The patient then vomited. Immediately following this she began to have abdominal pain located over the *left* side of the abdomen. She became dyspnœic at the same time. Her abdominal pain gradually became intensified until it was excruciating in type and the patient cried out due to its severity. Lips and fingers were cyanotic. Pulse was almost imperceptible.

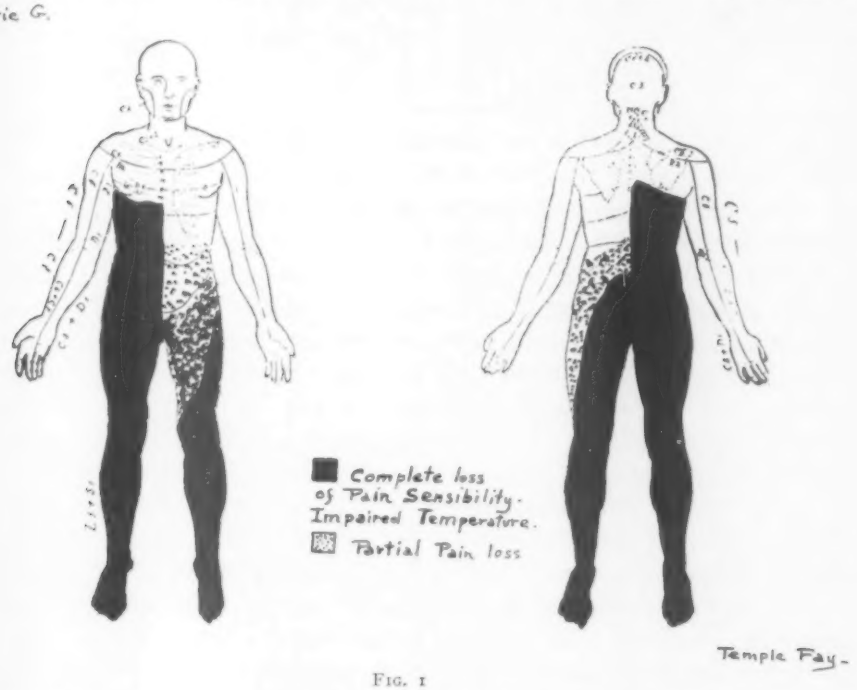

FIG. 1

Blood pressure 80/70 in each arm. Temperature 98°, pulse 110. Soft second sound almost inaudible. Urine contained myriads of leucocytes. Because of the sudden onset, low blood pressure, cyanosis, abdominal and brachial pain, coronary thrombosis or angina pectoris was considered. The plus four Wassermann made the impression of coronary sclerosis more probable. Doctor McMillan secured an electrocardiogram and ruled out an acute cardiac lesion. An abdominal complication was then suspected and Doctor Owen was called in consultation. The lack of rigidity of the abdomen, the presence of a tender mass in the upper abdominal area, with extreme pain; temperature 101, pulse 150, respirations 48; with incessant vomiting, not fæcal in character, presented a problem for diagnosis. The abdomen was not distended, but on viewing the patient's abdomen from the foot of the bed, it could be seen that on the right side in the middle of the abdomen, there was a globular swelling. Palpation elicited some pain and tenderness, but neither the pain nor tenderness was acute in character. The mass was doughy in consistency, there was no rigidity or distention of the abdomen. The rectal examination was negative.

The diagnosis of intestinal obstruction was made and the patient was operated upon immediately by Doctor Owen. Incision was made to the right of the mid-line without the need of an anæsthetic. On opening the peritoneum, considerable blood-stained fluid was found in the free peritoneal cavity and immediately there presented itself a large obstructed coil of intestines. This large loop of small intestine, estimated between eight and ten feet, was found tightly bound by a band of adhesions around the mesentery, and the whole loop of gut was twisted on itself by torsion. The torsion was corrected and the thick band of adhesions was cut between two ligatures. The constricted area was well back in the mesentery, but the wall of the bowel was glistening and was brownish in color. No area of actual gangrene nor necrosis was found. Hot towels were applied and the color of the intestines was partially restored. The area of involved intestines was too great and the patient's condition too grave to warrant any thought of resection. The gut was returned to the abdomen, and the abdomen closed by through-and-through sutures, with one suprapubic drain to the pelvis. The operation was performed without any anæsthetic, with the exception of during the manipulation of the intestines, when a small amount of nitrous oxide and oxygen was administered. She was returned to the ward in grave condition, and died the same night.

The reporter remarked that the interesting factors in this case include a method for determining the level of pain loss in cases where chordotomy is indicated, and this method can be accurately determined by examining the patient during the cutting of the anterolateral columns, under local anæsthesia. The sensory supply for pain to the peritoneum is another most interesting point in this case. It was not only possible to make an exploratory incision on the right side of the abdomen in this field of anæsthesia, without the patient's knowledge, but Doctor Owen noted the absence of any pain while manipulating or opening the parietal peritoneum. The visceral peritoneum, however, was painful, and required a slight gas anæsthesia in order to attempt surgical relief of the torsion and obstruction. This is evidence that pain fibres are supplied to the visceral peritoneum, either bilaterally from the side which still had pain sensation in the upper thoracic segments, or, that these pain fibres reach the cord at a level higher than the third thoracic segments; and hence that the pain experienced by the patient was carried by fibres which reached the cord; either on the left side or above the third thoracic segments.

Another interesting phase of this case was the masking of symptoms due to the chordotomy, and probably somewhat due to the presence of tabes. The absence of rigidity implies some factor associated with pain that was disturbed, or must be considered from the standpoint of her tabes. It is difficult to estimate whether the constriction of the mesentery by the band of adhesions first aggravated her abdominal pain; but in as much as her pains preceded her formal abdominal operation, and were not relieved by it, the possible source of adhesions following the former abdominal exploration does not lend sufficient weight to the consideration of intermittent obstruction as responsible for her pain. A clear-cut case of tabes makes the condition probably one of typical gastric crises; the sudden intestinal obstruction being an unusual complication.

Dr. Francis C. Grant said that the indications for chordotomy in gastric crises are clean-cut paroxysmal pain of such severity and frequency that

the sufferer is economically incapacitated. The term "economically" is used advisedly because infrequent attacks of abdominal pain are not sufficient indication for an operation such as chordotomy. In properly selected cases the results are quite satisfactory. In the past few years, he has performed six chordotomies for gastric crises. Three patients are alive, self-supporting and pain free. One death from luetic myocarditis occurred six weeks following operation as a direct result of the procedure. In this case vesical incontinence was noted. But in none of these patients was pyramidal tract involvement with impairment of motor function observed.

Doctor Fay has made an important observation in confirming Foerster's claims that the fibres for pain and temperature decussate promptly on entering the cord. It was hitherto supposed that these fibres travelled up the cord for several segments before crossing to the opposite side. Knowledge of this fact is of value for it indicates that chordotomy may be done at a lower level than hitherto supposed, provided that the section in the anterolateral columns completely severs all the fibres. It also obviates the necessity of sectioning posterior roots above and below the incision into the cord. The speaker has felt this latter precaution to be particularly indicated in relieving pain from gastric crises, since cord section at the fourth thoracic segment, the point of election, is not more than three or four segments above the region where pain fibres from the abdominal viscera presumably enter the cord. Doctor Grant believes that chordotomy under local anæsthesia is a little hard on the patient. To be sure he has only seen one case performed in this way. Although it was carried through by a surgeon skilled in the procedure and while every effort was made to prevent unnecessary distress, manipulation of the posterior roots caused considerable pain. In tabes dorsalis these roots are bound down by adhesions as is the cord itself, and considerable handling is necessary to free them so that the cord can be turned to perform properly the section of the anterolateral tracts. Curiously enough section of the cord itself is not painful.

The most interesting part of Doctor Fay's observations has to do with differentiation of the tracts for pain and temperature. As he states, it has been long suspected that the fibres subserving these sensations ran in separate areas. That he was able by careful sectioning to produce thermæsthesia without loss of pain sense confirms these opinions held heretofore on largely theoretical grounds. From the physiological and neuro-anatomical points of view this observation may justify the use of local anæsthesia. From the technical standpoint the speaker did not see how the method of section of the tracts described by Doctor Fay is an improvement on the method described by Frazier. In the case here reported, even with the use of local anæsthesia, motor weakness resulted, nor was the sensory level any higher than that obtained when a chordotomy hook is properly inserted into the cord and the section made.

While this report has added distinctly to our knowledge of the course of the pain and temperature fibres within the cord, Doctor Grant is sure that most surgeons will feel that our present methods of local anæsthesia are

inadequate sufficiently to control pain produced by the manipulations necessary to free delicate structures like the posterior roots from the adhesions which surround them in tabes. Since the carefully standardized technic described by Frazier can be used so successfully with general anæsthesia, whereby unnecessary pain to the patient is avoided, it seems unwise to abandon it even if thereby obscure anatomical problems may be solved.

Dr. Temple Fay remarked that in most chordotomies, including several cases which he recalled on the Frazier service, and in his own experience, one does get a traumatic myelitis associated with motor weakness, following operation, which may last for one week or ten days. It is due to trauma of the cord at the time of the chordotomy and does not necessarily indicate the section of the pyramidal fibres. The return of motor function is evidence that it must be due to trauma, and not to section, as no return of function ever occurs after destruction of the fibres within the spinal cord.

As to the type of anæsthetic, there is no doubt the patient is less comfortable under local, and yet with it one knows exactly what he is doing and the neurologist is able to tell the operator when he has cut the desired number of fibres, which he wishes to select. In the other cases also described, Doctor Wilson and the speaker were able not only to do a chordotomy, but to take away only the supply of pain from the right hip and leg. They did not want to destroy pain any higher than the hip and therefore preferred this method. Whether there is a greater hazard of destroying more than one wants to under general anæsthesia, it is difficult to say. Doctor Spiller has added a further refinement of his operation, which, with improvement in our technic of local anæsthesia, will be even more acceptable.

GASTRIC CRISIS COMPLICATING CANCER OF PYLORUS

Dr. Hubley R. Owen reported the case of a man, fifty years of age, who was admitted to the Woman's College Hospital October 22, 1925, with the chief complaint of rapid loss of twenty-five pounds in weight, general malaise, weakness and abdominal pain.

For about six months prior to his admission to the hospital this man had been having pain in the upper abdomen. The pain was severe in character; it had no relation to the taking of food. There was a sense of constriction around the upper abdomen. The pain was not referred and was unassociated with nausea and vomiting until recently. During the three weeks prior to admission to the hospital, he had lost twenty-five pounds in weight. His pain, which was occasional at first, during the past three or four weeks, has been constant and he has been nauseated and has vomited at frequent intervals. At no time has the vomitus contained blood.

When admitted the abdomen was fairly well nourished but the appearance of the tissues indicated loss of weight. No tumor nor masses could be felt. Patient complained of subacute tenderness on deep palpation of the epigastrium. No tenderness in the region of the gall-bladder nor appendix. Rectal examination revealed no abnormality. The patient had Argyll-Robertson pupils; a fine tremor of his hands; slight exophthalmos; complete loss of knee-jerks. Romberg's sign present. Hæmoglobin 65 per cent., red blood cells 3,250,000, white blood cells 9600. Examination of gastric contents showed no free hydrochloric acid; presence of lactic acid. *Blood chem-*

istry: Blood sugar 110, blood urea 18. Urine normal other than a trace of albumen. Wassermann was plus four in both antigens.

During the patient's stay in the hospital he had frequent attacks of severe girdle pain sometimes accompanied by vomiting. He frequently had the pain without either nausea or vomiting. *X-ray examination* was as follows: "There is a marked irregularity in contour about the pylorus with retention of the barium meal over seventy-two hours. No complaint of pain on manipulation of the stomach. Second examination of the stomach showed the same deformity and retention. The colon was negative."

The man was put on antiluetic treatment but continued to lose weight. He was operated upon October 30, 1925. A firm mass at the pyloric end of his stomach was disclosed; the stomach was dilated and thickened; the pylorus was greatly constricted and would not admit the end of the index finger; the mass was freely movable. No glands could be felt. As the mass was practically free of adhesions and as there was no evidence of metastasis, pylorectomy was performed. About one-third of the pyloric end of the stomach was removed. Following the operation the patient made a smooth recovery. He was discharged from the hospital November 16, 1925, and referred to the neurological service of the Medical Division, Department of Public Safety, At that time he was complaining of severe neuritis over the nerve trunks of the lower extremities. He reported for duty February 22, 1926, four months after his admission to the hospital. Shortly after this date, in spite of antiluetic treatment, his eyesight began to fail and the neuritis continued. He was admitted to the Philadelphia General Hospital February 19, 1927. It was found that he had advanced mitral and aortic lesions of his heart and a mass in the epigastrium. He had incessant vomiting, rapid emaciation and died in the Radiological Ward March 12, 1927.

The case is reported in conjunction with the previous case because of the confusing symptoms of girdle pains associated with a luetic lesion. The symptoms were typical of tertiary syphilis. An operation was agreed upon before a prolonged course of antiluetic treatment could be tried because of the X-ray findings and the result of the gastric analysis. Neither ulcer nor malignant growth was at first suspected.

The pathological report on the specimen removed was adenocarcinoma of the stomach.

POST-OPERATIVE MASSIVE ATELECTASIS: BRONCHOSCOPIC ASPIRATION

Dr. Calvin M. Smyth, Jr., reported the case of a young woman, nineteen years of age, a student nurse, who was taken ill May 13, 1928. She was admitted to the nurse's infirmary on that day with the diagnosis of acute appendicitis. She had had occasional atacks of pain in the right iliac fossa during the past year. Aside from this, and two attacks of tonsillitis, her health had always been excellent. Appendicectomy was performed on the afternoon of the day of admission, ten hours after the onset of the attack. The operation was done under nitrous oxide and oxygen anæsthesia, no ether being employed. The appendix which was acutely inflamed and on the verge of perforation was easily and quickly removed through a small McBurney incision and the abdomen closed without drainage. During the operation the patient did not cough, strain, vomit or become cyanosed. There was no vomiting during the period of reaction from anæsthesia.

On the following day a slight cough developed and a few squeaky râles could be heard at the left apex. Forty-eight hours after operation the axillary temperature rose to 103.6°, and the pulse to 170. She became delirious. Examination of the chest at this time showed the apex beat to be displaced to the left anterior axillary line. The entire left chest was flat to percussion and the breath sounds were almost inaudible except at the apex. The patient was quite cyanotic, appeared to have great difficulty in breathing and complained of a tugging or dragging in the left chest. Early the following morning she had a severe attack of dyspnœa which was relieved when she coughed up a small mucous plug. The diagnosis of massive atelectasis having been confirmed by X-ray examination (Fig. 2), she was placed on the sound side and encouraged to cough. The condition failed to materially improve and the patient's general condition became weaker. On May 18, five days following the operation and three days after the development of the atelectasis, X-ray failed to show any improvement and she was seen in consultation by Dr. Gabriel Tucker, who advised immediate bronchoscopic aspiration.

FIG. 2.—Appearance of chest immediately before bronchoscopic aspiration.

The bronchoscope was introduced through a laryngoscope; the right main bronchus was clear but the left was tightly plugged. Aspiration removed about five cubic centimetres of thick, tenacious material which later was found to contain the pneumococcus in pure culture. The reaction of the patient to this procedure was immediate and spectacular. The left chest which had been completely immobile expanded and the tugging sensation, of which she had previously complained, disappeared. X-ray examination made within fifteen minutes after the bronchoscopy showed the lung filled with air. (Fig. 3.) The patient passed a comfortable night and on the following morning coughed up several plugs similar to the one aspirated. The physical signs in the lung and the position of the apex beat rapidly returned to normal. There was no elevation of temperature after the aspiration and convalescence from the appendicectomy progressed uneventfully to recovery. The patient was discharged May 29, nineteen days after the original operation and twelve days after the bronchoscopic aspiration.

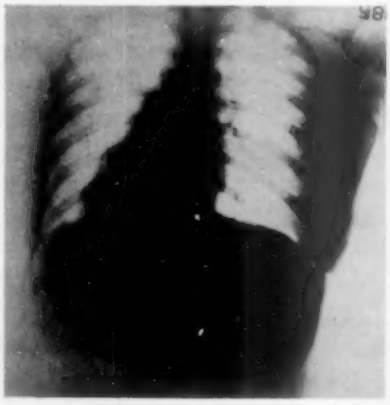

FIG. 3.—Appearance of chest fifteen minutes after aspiration.

The thing which impressed everyone who saw this patient was the complete absence of pain or shock occasioned by the bronchoscopy. The patient herself said immediately following the procedure that, while of course it was uncomfortable, the relief was so great that she would not hesitate to have it done again. Doctor Smyth remarked that he was reporting this case not on

account of anything unusual in the condition, but to again call attention to the fact that massive atelectasis could be relieved immediately and with complete safety by bronchoscopic aspiration. Treated by expectant and more conservative measures it usually required about three weeks for the lung to be restored to its normal condition.

Dr. Charles F. Nassau said that he wondered if these conditions of collapse of the lung are ascribed to the anæsthesia. He had a patient seven weeks ago who was operated upon under spinal anæsthesia, and who developed massive collapse of the lung the day following operation. He went down as fast as though struck with an axe. Doctors Clerf and Tucker were not available so he had to turn the patient on his good side and trust to luck. The following evening, after thirty-six hours, he was so much better without bronchoscopy that Doctor Clerf said to let him alone. He made a good recovery.

Regarding local anæsthesia, the speaker remarked that he had been doing a great part of his work with this form of anæsthesia for twenty-five years and had never seen massive collapse of the lung following it.

Dr. Walter E. Lee said that it is generally admitted statistically that the incidence of post-operative pulmonary complications is as great, if not greater, following local anæsthesia as occurs after general anæsthesia.

The first bronchoscopic drainage of a case of post-operative massive collapse was done by Doctor Tucker at the Germantown Hospital in 1923. Since that time nineteen cases has been drained bronchoscopically by Doctors Tucker and Clerf of the Chevalier Jackson Clinic. We must admit that we are peculiarly favored in Philadelphia in having available trained bronchoscopists to treat these emergencies, and the immediate relief that has been obtained in every one of these cases has more than justified the treatment. In only one of them was it necessary to repeat the drainage. In the hands of a skilled bronchoscopist we can testify that it is not as formidable a procedure as one would imagine. It is usually completed in three to five minutes and the immediate relief experienced by the patient has convinced them of its value and all of them have said that they would willingly have it repeated, if necessary. In a recent case by Doctor Clerf, when threatened with a second bronchoscopic drainage, because the patient refused to cough up the obstructing bronchial secretions he said: "Bring on the bronchoscope, I would far rather have that than the pain of coughing."

It must be remembered that the purpose of the bronchoscopic drainage is not to completely remove the masses of bronchial secretions, but to relieve the point or points of bronchial obstruction and establish an airway beyond these obstructions, and thus restore the cough reflex and stimulate the patient to expel these masses of secretion. That the obstruction is due to the sticking of the tenacious material to the walls of the bronchi has been demonstrated time and time again at the time of the bronchoscopic examination. Undoubtedly, in the large majority of cases, this obstruction is overcome by the patients themselves and they will give you the history of coughing up

large quantities of sputum following some change of position, or some sudden excitement, and after the expulsion of the secretion their subjective symptoms will be immediately relieved. Doctor Santee has actually observed this relief of obstruction under the fluoroscope when he was examining a patient, and his suggestion that we turn the patient on the opposite side is at times all that is necessary.

Doctor Scott, of Rochester, has suggested a very valuable procedure in the use of inhalations of carbon dioxide to increase the depth of insipration, thus restoring the cough reflex and promoting the expulsion of the tenacious secretion. If one understands the mechanism of post-operative collapse and appreciates that the therapeutic indications are the relief of bronchial obstruction and the establishment of an airway so that the cough reflex will be restored, he can intelligently employ these measures. In the early stages, deep breathing or a change of posture may be all that is necessary. In the same period or a little later, the deep inhalations of carbon dioxide, may suffice but after a lapse of several days, because of the gradual increasing viscosity that follows the loss of the fluid content of the secretion, bronchoscopic drainage should be considered. In the later stages, the simpler procedures are rarely successful, while bronchoscopic drainage gives immediate and positive relief.

Present experience shows that bronchoscopic drainage is not a formidable procedure, and after simpler measures fail, the patient should always be given the benefit of such a procedure.

BULLET WOUND OF INTESTINES AND KIDNEY WITH NEPHRECTOMY

Dr. Benjamin Lipshutz presented a man, thirty-eight years of age, who was admitted to the Mt. Sinai Hospital January 19, 1929. Twenty minutes before admission to the hospital while bending over, a revolver dropped from his pocket and discharged, the bullet entering a little below and to the left of the umbilicus. He immediately complained of violent abdominal pain and began to feel faint; the speaker saw him one hour later; he was in shock. The pulse was feeble, rate about 90, blood pressure 70; examination of the abdomen showed diffuse tenderness and rigidity, and palpation over the back showed the bullet below between the eleventh and twelfth ribs. Immediate operation was carried out under local anæsthesia, supplemented with nitrous oxide and oxygen. An upper left rectus incision was made; on opening the abdomen free blood clots and intestinal contents were disclosed. Examination of the spleen, pancreas and liver disclosed no injury. The intestine, namely, the upper ileum and jejunum as far as the duodenal-jejunal junction disclosed fifteen perforations; these were closed with interrupted Lembert sutures, care being taken to avoid any occlusion of the lumen. Bleeding still continued, and examination of the root of the mesentery showed a point of rupture which was oozing blood; the bleeding points were ligated and the rent in the mesentery closed with ligatures. The root of the mesentery of the jejunum also disclosed a site of oozing and an increasing hematoma; the latter was opened and found to contain blood clot. Bleeding points were ligated and the mesenteric wound closed. Bleeding still persisted from the posterior part of the abdominal cavity and the presence of a large dark red swelling over the region of the kidney indicated evident accompanying injury to the kidney or one of the socalled massive hæmorrhages of the renal bed. The parietal peritoneum was separated from the abdominal

wall laterally and posteriorly in order to gain access to the kidney through the abdominal incision. Here it was found that bleeding was violent and active. The renal artery was not ruptured but the vein was injured and the kidney was torn to a pulp. A rapid nephrectomy was performed. The abdominal wound was closed and a stab wound made posteriorly through which a gauze pack was introduced. Convalescence was smooth except for the first forty-eight hours when liquids were limited and marked slowing of absorption was noted. The wound healed by first intention with the exception of stitch infection at the upper angle of the incision. He recovered satisfactorily and is now returned to work.

This case is an excellent example of the value of intraperitoneal exposure of the kidney in an acute injury involving the abdomen and kidney. It permits the surgeon with relatively little loss of time and no danger from increased shock, to handle both the abdominal injury and the renal injury.

In going over the statistics of associated abdominal and renal injuries, those available are largely concerned with cases the result of war injuries and it seems hardly fair to compare them with civil injuries. The prognosis is almost hopeless. In the British war statistics of 2121 cases of abdominal wounds, 155 were associated with a kidney injury. In Läewen's statistics of 159 cases, twenty-nine had accompanying renal injury, and he stated that from his personal experience of thirty-four cases of combined renal and intestinal injury, but three recovered and he thinks the prognosis almost hopeless. In the German literature, Most reported seven cases and all died. In the review of the American experience as to whether to explore the kidney first and then the abdomen or *vice versa*, the opinion was for the former because of the danger of carrying infection from the intestinal contents into the retroperitoneal tissue. But with the technic followed here, the danger of contamination is little.

Doctor Lipshutz has had three cases of this type of injury; in two other instances the kidney was not injured but there was the socalled massive hæmorrhage of the renal bed with a large hematoma, and the same method of approach was used. Exposure is rapid and the presence of the hematoma aids the surgeon to rapidly detach and separate the peritoneum.

Dr. Charles F. Nassau said that the most important thing in this case was the recognition of the damage to the kidney or renal vessels. Whenever one opens the abdomen for gunshot wound and finds considerable hæmorrhage back of the peritoneum, it should be determined by one method or another (stripping the peritoneum or drawing back to expose the kidney) how much hæmorrhage there is and its origin. Otherwise one may do a wonderful operation on the intestinal perforation and still lose the patient from a kidney injury.

REVIEW OF THE OPERATIONS DONE ON THE GALL-BLADDER AND DUCTS

Dr. John H. Gibbon read a paper with the above title for which see page 367.

Dr. John H. Jopson remarked as to the choice of operation, that he had a well-defined practice of his own, which he has modified in recent years fol-

lowing disasters in older people; he agreed with Doctor Gibbon that 70 per cent. of diseased gall-bladders can be removed with benefit to the patient. In patients over sixty, however, where there is some question as to the condition of the myocardium and where the operation of cholecystectomy seems to have a reflex action on the circulation, post-operative death has occurred, due to a failing myocardium; and so he has come to look with a doubtful eye upon cholecystectomy as a routine procedure in these older patients. Of course, after cholecystectomy he has had recurrences and in one case he removed the gall-bladder ten years afterward.

Following cholecystostomy in younger patients, he believed about 50 per cent. would have recurrence; but in patients sixty or over, unless there is some organic change in the gall-bladder which clearly calls for its removal, he is satisfied with cholecystostomy. In certain other cases of gangrene or virulent infection of the gall-bladder, the less done the better (just as in other parts of the body), and it has always seemed that quick drainage and quick retreat were in order. In the cases between these two groups, with the thick and œdematous gall-bladder which will probably never return to a normal and healthy condition, the speaker had in several instances practiced with satisfaction the subtotal operation, resecting the gall-bladder and leaving about one-fifth of it into which a tube for the drainage of bile is sewn. As to the recurrence of symptoms after operation for obstruction of the duct, whether this is due to operative injury or to stenosis following ulceration of the duct from pressure of calculi, he noted that Doctor Gibbon believes it may be due to ascending infection from the gastro-intestinal tract. One knows that the further down the anastomosis is made, the more frequent subsequent infection usually is. There is probably no difference in this respect between stomach and duodenum, and the most successful result the speaker has seen followed the implantation by him of the injured duct into the stomach. The results have been excellent and the danger of injury to the ducts is minimized.

Dr. George P. Muller said that he performed cholecystostomy in most cases of empyema, because he feels that when one has ripped the gall-bladder from the liver and opened up the connective tissue spaces to find the cystic duct, one has opened up avenues for infection, because all the lymph from an infected gall-bladder must be infected, and it adds to the spread of infection. Some time ago he performed cholecystectomy in most cases of empyema, but last year reversed the procedure and performed cholecystostomy. The mortality was lower. On the other hand, dilatation of the common bile duct following cholecystectomy does not occur unless a normal gall-bladder has been removed. Doctor Gibbon thinks that a compensatory dilatation has already occurred and that the patient has had time to become used to such a phenomenon. This may be so, but when definite pathology is present in the gall-bladder with the jeopardy of life from acute infection, the speaker cannot see the wisdom of doing anything but cholecystectomy, except in old

people, because in them the period of time in which gall-stones may recur is limited and the number of times must necessarily be small.

Dr. J. Stewart Rodman said that while he had never seen an attempt of the gall-bladder to reform from the stump of the cystic duct, he would ask Doctor Gibbon if he has done so. He recalled that Doctor Sweet reported some experimental work a few years ago to this Academy showing that such might happen.

Dr. Calvin M. Smyth, Jr., said that the work of Sweet, referred to by Doctor Rodman, had been done by Doctors Hartman, Wood and himself in Sweet's laboratory in 1916 and had been published in the Annals of Surgery in a paper entitled "The Results of High Ligation of the Cystic Duct in Cholecystectomy." Two cases of reformation of the gall-bladder were reported; in one of the cases reformation of stones had occurred. Attention was also called at that time to the generalized dilatation of the common bile duct and all of the branches of the hepatic duct which occurred following cholecystectomy.

Dr. Astley P. C. Ashhurst remarked that he was what might be called a "cholecystectomist." He recalled receiving, a few years ago, a questionnaire asking how many cholecystostomies he had done in the previous two years. On looking up his records to reply, he found he had not done any in that length of time. Since then, he has done four cholecystostomies. The speaker looks upon the diseased gall-bladder as a menace and thinks it deserves to be removed, especially if it has stones in it.

Doctor Gibbon had left several impressions on his mind: *First* that he thinks the recurrence of symptoms after a cholecystostomy may be due to the escape of stones from the common duct (where they were overlooked) into the gall-bladder. Doctor Ashhurst does not believe this can occur, and probably misunderstood him. *Second*, that he thinks the existence of a dilated common duct means obstruction to the duct and that it should, therefore, be explored. In cases of functionless gall-bladder, the common duct is already dilated and as the dilatation means that the gall-bladder is of no use, the gall-bladder should be removed. The speaker is not in the habit of opening the common duct unless there is evidence at the time of operation that it has been or is still diseased.

Dr. John H. Gibbon said that Doctor Jopson's statement that the higher the anastomosis with the gastro-intestinal tract, the less likelihood of infection is interesting. Most of the speaker's cases have been with the duodenum. In the experimental work with dogs, the anastomosis was to the stomach and yet they all developed this type of infection.

The object of his paper was to encourage the exercise of judgment, of brains, and of thought in the performance of an operation and its selection and not to go at it mechanically. Doctor Gibbon did not wish to leave the impression that in common-duct disease due to non-function of the gall-bladder, the duct should be opened; what he wanted to make clear was that

when stones are found in the gall-bladder and the common duct is dilated, one ought not to be content with palpation, because one cannot always feel stones in the presence of dilatation, and it is wiser to operate in such cases. His point was for the removal of any stone rather than with the idea of opening the dilated duct. Also, he said that he did not know that this dilatation of the duct is harmful. Judd at an American Surgical Association meeting showed a case of dilatation of the entire biliary tract after removal of the gall-bladder, so that it would seem that dilatation does take place where the gall-bladder is out of commission due to disease. Removal or obliteration of the gall-bladder causes a compensatory dilatation of the duct. Division should be done down close to the common duct; a number of operators think the only thing necessary is to take the gall-bladder out and they often overlook this important point and do a great deal of harm. It must be taken out close to the common duct, regardless of the situation.

STATED MEETING HELD MAY 7, 1929

The President, Dr. Astley P. C. Ashhurst, in the Chair,
Calvin M. Smyth, Jr., M.D., Recorder

COLORED MOTION PICTURES OF SURGICAL OPERATIONS

Dr. Walter E. Lee demonstrated a film of motion pictures of operations, made in colors. These pictures represented the first attempt to make colored reproductions with the artificial light of the operating room. A great handicap has been that in looking at a black and white picture, one keeps trying to interpret the film in colors and this makes it an effort to follow the technic. The speaker did not consider the demonstration perfect but presented the film because it seemed to be the first evidence of success in attempts to employ this method of teaching surgical technic.

TENDON TRANSPLANTATION FOR WRIST DROP

Dr. De Forest P. Willard presented a man who was injured September 27, 1926, when he received ten fractures of the right upper extremity and an injury to the musculo-spiral nerve. At least three of the fractures were compound. He was treated at St. Luke's Hospital, Bethlehem. Open reduction of the fractures of the radius, ulna and humerus were done. All the fractures healed without infection. In April, 1927, a bone-grafting operation was performed for an ununited fracture of the middle of the humerus. In May, 1928, the musculo-spiral nerve was operated on for persistent wrist drop. The nerve was found to be a mass of fibrous tissue, and union of the nerve tissue was found to be impossible. During the past winter he was examined by neurologists in New York and Philadelphia, and further nerve operations were considered useless. Tendon transplantation was suggested. After full discussions of his needs, it was decided that individual extension of his fingers was not necessary, but that strong extension of the fingers to the 180° position and sufficient extension of the thumb extensor and one to the common extensor. This procedure usually functions well for a short period of time, but the weak flexor often proves inadequate for the necessary work and the tendon stretches and the finger flexion recurs. In this patient scars of the operative incisions on the bones of the forearm

lay in the paths of the tendon transplants and it was felt that these might interfere with muscle function. Therefore, to give greater extensor power, the following operation was done January 22, 1929. The flexor carpi radialis was freed from its insertion, dissected back as far as possible and passed around the radial side of the forearm. It was then passed through the extensor tendon of each finger separately (proximally to the annular ligament) and sutured with silk to each tendon. The flexor carpi ulnaris was treated similarly and brought to the extensor surface around the ulna and sutured to each extensor tendon in the same way. This gave the combined pull in the normal direction of the extensor tendons and prevented the dislocation of the extensor tendons to either the radial or ulnar side. The palmaris longus tendon was also freed from its insertion and brought over the ulna and sutured into the long extensor of the thumb. Assisted active motion was started on the third day to prevent the formation of adhesions and active motion began on the seventh day. In ten days the patient was able to actively extend the fingers and strong extension to 180° was obtained in four weeks. He has now actively used his hand for nearly three months and muscular power is increasing.

The case is reported in the belief that the transplantation of two flexor tendons into the finger extensors, one passing on each side of the forearm, will give stronger and more powerful function.

Dr. Walter G. Elmer said that this is the most perfect restoration of function following tendon transplantation in the forearm that he has even seen.

ADENOMA OF THYROID WITH TORSION OF LARYNX

Dr. Fredrick A. Bothe reported the case of a negress, sixty-two years of age, who was admitted to the Presbyterian Hospital December 20, 1928, in the service of Dr. John Speese, through whose courtesy the reporter was permitted to operate upon this patient and report the case. The patient gave a ten years' history of the gradual development of a thyroid tumor until it had reached the size of a medium-sized grapefruit seated on the left side of her neck but extending well to the right of the midline. Attacks of tachycardia, choking spells and hoarseness have become increasingly frequent and severe.

The patient was placed under the routine management for a toxic adenoma and in addition steam inhalations were administered to decrease the acute congestion of the epiglottis and larynx which was super-imposed upon the chronic congestion. Eight days after admission to the hospital the adenoma was removed under local anæthesia. The pathologist pronounced it a toxic fœtal adenoma. Immediate relief from the choking spells was obtained following the operation but the hoarseness of the voice did not disappear for three weeks. At this time a second laryngoscopic examination was made by Doctor Cariss. The œdema of the epiglottis and the arytenoid area had disappeared. The larynx had returned to the midline and both the true and false vocal cords were normal in position and appearance. She was discharged from the hospital January 24, 1929, twenty-seven days after operation, feeling much stronger, was relieved of the choking spells and hoarseness. Her pulse rate had settled down to 82, was of good volume and her blood pressure had fallen to systolic 138 and diastolic 70. She returned to the Follow-Up Clinic four months after the operation and was relieved of the local symptoms which the adenoma had caused. She had not regained her entire normal strength but was able to do a part of her housework for

the first time in two and one-half years. An X-ray picture of the chest showed the trachea had returned to the midline. She still experiences occasional mild attacks of tachycardia and palpitation. Her nervousness had greatly decreased but had not entirely disappeared.

The degree of torsion of the larynx with œdema of the epiglottis and arytenoids and the marked posterior lateral displacement of the common carotid artery were the findings which prompted the report of this case. The outward displacement of the common carotid artery is of diagnostic value in adenomatous goitres, as in tuberculous or malignant tumors this artery lies in the centre of the mass.

GANGRENOUS INFECTION OF THE HAND AND FOREARM FOLLOWING HUMAN-BITE

Dr. John B. Flick reported the case of a negro man, aged thirty years, who was admitted to the Pennsylvania Hospital December 30, 1927, with the history of having been bitten on the right thumb by another negro five days previously while engaging in a street fight. The hand was greatly swollen, he had a temperature of 102° F. and seemed toxic. The hand and forearm were incised under a general anæsthetic and pus evacuated. The tissues exposed in the wound were œdematous and had a peculiar greenish-gray appearance. The odor was most offensive and reminded one of that which is given off in spirochætal pulmonary gangrene. A dark field examination of the pus from the hand showed numerous organisms, some of which were motile and which were thought to be spirochætes. Subsequent smears showed definitely the presence of spirochætes. A non-hæmolytic staphylococcus albus was isolated on culture, but no growth of the spirochætes was obtained. A guinea pig inoculated in the groin remained healthy. It was killed almost two months later.

Fig. 1.—Infection of the hand and forearm following human-bite, showing the extensive destruction of tissue.

Five days after the patient's admission to the hospital it was noticed that he had jaundice and he began to have chills and sweats. There was extensive destruction of tissue in the hand and forearm and amputation of the forearm was advised. (Fig. 1.) This the patient refused. A blood culture taken at this time failed to show a growth. The patient died on January 9, 1928, sixteen days after the injury was received.

While the type of spirochæte was not identified nor the fusiform bacillus of Vincent isolated, this case suggested that the organisms of "Vincent's Angina" so often found in the human mouth might be factors in determining the seriousness of human bites. With this in mind the reporter searched the literature for cases similar to the one cited.

Hennessy and Fletcher report the case of a Malay who was bitten on the left forearm and thumb by another Malay and who developed an infection of the thumb with extensive destruction of tissue and disorganization of the thumb joints. The pus from the wound contained fusiform bacilli and enormous numbers of spirochætes. They refer to other cases reported

by Peters. The following is taken from Hennessy and Fletcher's article: "The infection of wounds caused by the teeth has been reported by Peters. In one instance a laborer injured his fingers by striking a man in the mouth. The injury was followed by intense swelling, œdema, and a foul discharge in which fusiform bacilli were discovered in association with streptococci, but without spirochætes. The same author describes the case of a bartender who hit a man in the mouth and injured his own hand. Despite free incisions and soaking in antiseptic lotions there was deep destruction of tissue and the hand did not heal for fifty-four days. In this instance great numbers of spirochætes were associated with the fusiform bacilli. Peters also mentions the case of a seven-year-old child who suffered from partial gangrene of one of her index fingers as the result of infection with spirochætes and fusiform bacilli attributed to the child's habit of biting her nails with her carious teeth." P. H. Hennessy in another article, again reports the Hennessy-Fletcher case given above and adds four cases in which the appearance of the lesion, the character of the pus and the course of the disease strongly suggested infection with the organisms of "Vincent's Angina," but in which no bacteriological studies had been made. A common feature of all the cases reported seems to have been an extensive destruction of tissue.

Dr. Hubley R. Owen showed some slides demonstrating similar cases, although he stated the condition in them was not as severe as the form of gangrene Doctor Flick had discussed. He stated that most of the cases which had come to the attention of the Police Surgeon's office had previously been sewed up in some dispensary. While he said he was not prepared to say what was the really correct method of first-aid treatment in these conditions, it is not suturing. In his service he has tried every method of treatment, including the actual cautery and Dakin's solution and still has considerable trouble in preventing ankylosis of the metacarpal and phalangeal joints.

GANGRENOUS PANCREATITIS

Dr. Elridge E. Eliason and (by invitation) Dr. James Lacey reported the case of a woman, fifty years of age, who was admitted to the University Hospital, in the service of Doctor Eliason, November 30, 1927, with the chief complaint of abdominal pain and vomiting.

For the past year before admission she had complained of repeated attacks of nausea and vomiting, followed by severe, steady, generalized abdominal pain. The severity of the attack was usually over in four hours and she was entirely relieved of symptoms in twenty-four hours. There was no jaundice, or loss of weight. On admission the patient was having an attack which had lasted four days and was more severe than any previous attack.

On physical examination the abdomen was tender throughout; most marked in the epigastrium. There was rigidity in the epigastrium and moderate distention throughout the abdomen. Peristalsis was practically inaudible. On the day following admission the tenderness and rigidity seemed more marked on the left side of the epigastrium. The leucocytes were 29,200 and the hæmoglobin was 100 per cent. The plasma carbon dioxide was 47 volumes per cent. The urine contained urobilin and bilirubin.

The temperature, pulse, and respiration on admission were 99.2-104-20. A diagnosis of cholelithiasis was made on admission. With the shifting of the pain and tenderness and rigidity to the left side of the abdomen on the morning after admission, an additional diagnosis of acute pancreatitis was made.

At operation, December 2, 1927, the peritoneal cavity was found to contain chocolate-colored fluid and fat necrosis was seen in the peritoneum. The pancreas was swollen and indurated. The entire gland was black in color and gangrenous throughout. The gall-bladder was opened and found to contain several hundred small, yellow stones which were evacuated. No stones were palpated in the common duct. The gastrohepatic omentum was opened, exposing the pancreas. Drainage of the pancreas was established by multiple cautery incisions. The gall-bladder and pancreas were drained, externally.

The post-operative course was stormy and on the fifth day she developed the physical signs of atelectasis of the left lower lobe. The temperature, pulse and respiration remained elevated, the abdomen was distended and there was distressing hiccough. On the thirteenth post-operative day the signs of fluid were demonstrable in the left chest. The blood sugar ranged from 135 to 99 milligrams per 100 cubic centimetre of blood, the patient being on a diabetic diet with insulin. The abdominal wound drained profusely of necrotic material. On the fourteenth post-operative day a small amount of straw-colored fluid was removed from the chest. Aspiration was repeated six days later and 100 cubic centimetres withdrawn. On the twenty-eighth post-operative day a fluctuating mass was palpated in the left upper quadrant. On the thirty-eighth post-operative day the patient was again operated upon and an abscess near the tail of the pancreas drained through the subcostal region of the left loin. This operation was followed by marked improvement. Forty-nine days after operation the chest was again tapped and 650 cubic centimetres of fluid removed. Following this both wounds drained profusely though the temperature was slightly hectic. The patient was allowed out of bed after seventy days from the original operation. A peculiar feature was noted during irrigations of the abdominal wounds; the patient would cough and taste the irrigating fluids and a diagnosis of abdominobronchial fistula was made. However, improvement continued and the patient was discharged February 28, 1928, three months after admission. At present she is apparently in perfect health.

INCARCERATED RETROCÆCAL HERNIA—GANGRENOUS APPENDICITIS

Doctor Eliason presented a man, sixty-five years of age, who was admitted to the University Hospital in the service of the reporter, November 20, 1927, whose chief complaint was pain in the lower abdomen, nausea and vomiting and constipation. Seven days prior to admission he drank heavily and ate various sea foods. The next day he complained of pain in the lower abdomen, followed by nausea and vomiting. He was confined to bed from then on; the pain became worse and localized in the right lower quadrant. Vomiting continued and there was no bowel movement from onset to admission.

On admission the temperature and pulse were normal. The blood pressure was 115S-50D. The patient was emaciated and weak. The leucocytes were 17,800. The abdomen was distended and tympanitic. There was tenderness in the lower abdomen, especially the right lower quadrant, where a mass could be palpated. A diagnosis of appendiceal abscess was made and the patient was operated upon immediately. The right lower quadrant

was opened through a gridiron incision and a loop of terminal ileum was found to be incarcerated in a retrocæcal hernial sac, with a tightly constricting neck. On stretching the neck of the sac the hernia was found to consist of about six inches of terminal ileum and the appendix which was gangrenous. The ileum had perforated just within the constricting neck and the sac contained pus and some liquid fæces. The perforation was oversewed and the appendix removed. The opening of the pouch was repaired around a drainage tube and an ileostomy was done proximal to the obstructed loop.

The immediate post-operative course was complicated by delirium tremens which cleared up in forty-eight hours. Normal bowel movements started on the fourteenth post-operative day and the ileostomy tube was removed. The patient was discharged December 9, 1927, on the nineteenth day after admission. He is now perfectly well.

PERFORATED PEPTIC ULCER

Dr. Elridge E. Eliason presented a man, twenty-nine years of age, who was admitted to the Howard Hospital May 26, 1922, on account of pain in the abdomen, vomiting and weakness.

The history of illness started three years prior to admission, when the patient was seized with severe pain in the abdomen. Following this attack he was confined to bed for one week. During the intervening three years the patient had repeated attacks of abdominal pain following the ingestion of sweet foods or occasioned by worry. One week before admission he experienced an exceptionally severe attack of pain in the abdomen which was not relieved by the medicine he was accustomed to take. From the onset of this last attack he had vomited everything he ate.

Physical examination was negative save for the abdomen, which was slightly rigid throughout and tender to deep pressure over the epigastrium, especially to the right of the midline. The temperature, pulse and respiration on admission were 99-112-26 respectively. The urine analysis was negative save for a trace of albumin. The leucocytes were 11,400. Laparotomy was performed May 27, 1922, and a duodenal ulcer was found which had perforated. The gall-bladder was freed from the mass of adhesions. The ulcer was oversewed. A posterior gastro-jejunostomy was performed and appendectomy done.

September 18, 1923, the patient was again admitted to the Howard Hospital, complaining of severe abdominal pain, but no nausea. Physical examination of the abdomen showed no distension or rigidity, but two points of tenderness, one below and to the right of the umbilicus and the other at a lower level and to the left of the umbilicus.

The temperature and pulse were slightly elevated. The leucocytes were 16,000. The urine analysis was essentially negative. A diagnosis of perforated jejunal ulcer was made and an immediate operation was performed. The jejunum was slightly enlarged, dull red in color and covered by a small amount of lymphatic exudate. A perforated ulcer was found opposite on the mesenteric border distal to the gastro-jejunostomy. This ulcer was oversewed and a second incision was made to the right of the first, exposing the pylorus which was obliterated by two sutures of kangaroo tendon.

An X-ray examination after discharge showed none of the opaque meal leaving the stomach by way of the pylorus. Following this second operation the patient was symptom-free for five years and held rigidly to his diet until the last few months of this period.

On the morning of January 29, 1929, he was seized with severe, agonizing pain in the centre of the abdomen which did not radiate. He went to work, however, and at the completion of his milk route the pain was still more severe. He was admitted to the University Hospital the evening of the same day. Physical examination of the abdomen at this time showed extreme tenderness throughout the upper abdomen, being most severe in the left upper quadrant. Deep palpation was not especially painful. The abdomen showed very little rigidity, but the wall was extremely thin over the upper half of the abdomen. Peristalsis was diminished. Rectal examination was negative. The blood pressure was 140S-64D. There was slight elevation of pulse and temperature. The leucocytes on admission were 7900, but one hour after admission a second count was 11,400. The urine was negative. An X-ray examination failed to reveal the evidence of gas under the diaphragm.

Laparotomy was done by Doctor Eliason four hours after admission. The gastro-enterostomy site was examined and found to be functioning normally. An ulcer was found on the jejunum proximal to the gastro-jejunostomy. The loop of jejunum distal to the gastro-jejunostomy was firmly adherent to the proximal loop at the ulcer site and there was a kissing ulcer of the distal loop of the jejunum. The proximal loop was kinked and partially obstructed and there was dilatation of the gut above the obstruction. The distal loop was hypertrophic but not obstructed, and showed the scar of previous ulcer five years before. In an attempt to free the adhesions the jejunal wall was perforated at the point of ulceration. The ulcer of the distal loop was found to have penetrated to the serous coat. The ulcerated areas were excised with the cautery and a jejuno-jejunostomy was performed at this site. An area of calcification was found in the right rectus muscle.

The convalescence was complicated by a breaking down of the superficial tissues of the wound and a bilateral basal atelectasis.

SURGERY IN BREAST TUMORS

Dr. Edward J. Klopp pronounced the annual oration entitled "Surgery in Breast Tumors; Problems Concerning Diagnosis and Treatment," for which see p. 424.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD APRIL 10, 1929

The President, Dr. Frank S. Mathews, in the Chair

CARCINOMA OF TRANSVERSE COLON

Dr. Guilford S. Dudley presented a man who, in February, 1923, was admitted to the Second Surgical Division of Bellevue Hospital. He was then sixty-one years of age. He complained of intermittent cramp-like pain, in the lower half of the abdomen, of six months' duration. This pain had no relation to meals, although it was somewhat relieved by belching of gas. There had been no change noticed in his degree of constipation and no blood in his stools. The only other significant fact in his history was the loss of an indefinite amount of weight.

Examination showed a small, irreducible, umbilical hernia, and a gastro-intestinal series of X-rays showed a defect in the mid-portion of the transverse colon. The pre-operative diagnosis was carcinoma of the transverse colon.

Through a transverse incision, excising the umbilicus, an excellent exposure was obtained and a carcinomatous mass, one and one-half inches in length and one inch in diameter, involving the mid-portion of the transverse colon was found. There were no demonstrable metastases and no evidence of obstruction to the bowel lumen. The tumor, with one and one-half inches of healthy gut on either side of it, was removed and the continuity of the intestinal tract restored by a lateral anastomosis.

Convalescence was entirely satisfactory and he left the hospital on the thirty-second day after operation. Post-operative barium enema X-ray showed evidence of the anastomosis and a colon which filled without obstruction.

Pathological examination of the excised specimen showed it to be adenocarcinoma with some ulceration of the mucous membrane but without obstruction to the lumen. The tumor had extended entirely through the wall of the gut to the subserosal tissue, but sections of several large lymph nodes present in the adjacent fat showed only inflammatory hyperplasia.

His subsequent history has been one of continued improvement and gain in weight until the past five or six months. During this latter period of time, his diet has been restricted by his physician because of an elevated blood pressure, and the patient attributes his recent loss of weight to this cause. He has no symptoms referable to the intestinal tract and, as far as can be determined by physical examination, has no recurrence of the growth.

BILIARY DUCT LITHIASIS

Doctor Dudley presented, also, a man, thirty-seven years of age, who was operated upon seven years ago for gall-bladder disease. The record does not state whether or not his gall-bladder contained calculi at that time.

He was well until three weeks prior to admission to the Second Surgical Division of Bellevue Hospital June 15, 1928. At this time he began to suffer from a recurrence of biliary symptoms.

At operation his gall-bladder was found firmly embedded in a mass of inflammatory adhesions, but its walls were not thickened and it contained no calculi, nor were there any calculi in the cystic duct. Its size was approximately three times that of the normal gall-bladder and it contained normal-appearing bile. The biliary ducts were palpated and were found not to be dilated. No calculi were palpated within the ducts. His liver appeared normal. His gall-bladder was removed and the wound drained. For several days bile drainage was profuse, but other than this his convalescence was entirely satisfactory, and he left the hospital twenty-three days after operation with a granulating wound which subsequently healed completely.

He remained well for about one month, but at the end of this time again suffered from upper abdominal symptoms and rapidly lost twenty-five pounds in weight. He did not become jaundiced nor did he give any history of chills, fever, or sweats. He was readmitted to the hospital and kept under observation for three weeks. During the first week there was a persistent fever of about 100° and tenderness over the lower portion of the operative scar. During the following two weeks his temperature remained normal. He showed no jaundice, his icteric index was 13, and X-ray examinations ruled out any lesion of the gastro-intestinal tract.

At operation the common and right hepatic bile ducts were found to contain an enormous accumulation of calculi. The common duct was opened and many, though not all, of these calculi were removed. Because of the patient's condition the operative procedure was terminated by the insertion of a fenestrated catheter into the hepatic duct for drainage and for the subsequent administration of bile to the patient.

His post-operative course was exceedingly severe. During the week that the catheter remained in place, a daily average of twenty to twenty-five ounces of bile drained through it. This was given back to him by means of a nasal tube into the stomach. Two weeks after operation he became deeply jaundiced and his icteric index rose as high as 40. Throughout his hospital convalescence, his jaundice and icteric index fluctuated considerably, but with a gradual general downward tendency. Similarly, his drainage of bile continued to be profuse, but also with a tendency to become less in amount. After removal of the catheter drainage a large number of biliary calculi were discharged through the wound. Many of these appeared to be casts of the smaller biliary radicals, others were distinctly faceted and the remaining material was of a granular, sand-like nature. Marked asthenia, an acute exacerbation of a chronic otitis media, and multiple furuncles were further complications. At the end of about three months, he began to show improvement and he was able to leave the hospital January 28, 1929, one hundred and twenty-four days after operation.

Since that time his sinus has discharged but one small calculus and its biliary discharge has diminished to a scant amount. Whether all of his calculi have been eliminated and the formation of further calculi ceased or whether he has reëstablished a lumen through a duct filled with calculi, as was the situation prior to his second operation, remains to be shown by his subsequent course. Because of the slight jaundice present before his cholecystectomy was done, it seems reasonable to assume that one or a few calculi within his ducts were overlooked at that time. The interesting feature of his case and the reason for his presentation to the society lie in the production of the enormous number of biliary duct calculi within a period of two months following the removal of his gall-bladder.

Dr. Edwin Beer doubted whether the stones in Doctor Dudley's second case had reformed in the ducts, because Doctor Dudley had failed to open

the common duct and these stones may have been overlooked at the first operation. If the common duct were opened and found empty and in the post-operative drainage no stones had been discharged through the drainage tube, a reformation of stones in the duct system might have been considered as likely.

Of late there had been a number of cases in the literature purporting to be reformation of stones in the gall-bladder and in the hepatic ducts which do not bear close scrutiny. Reformation of stones in the gall-bladder is rare and reformation in the non-obstructed common duct leading into the hepatic ducts is also rare. With stone obstruction in the common duct and a mild degree of cholangitis, stones seem to form readily behind the primary stone in the common duct and these stones may develop throughout the hepatic duct system, following six weeks' obstruction. The same type of rapid stone formation behind obstruction occurs in stagnant urine. Here, also, the occurrence is infrequent though more frequent than in the liver. Stones in the common duct may apparently be present for a long time without causing any symptoms and without inducing any secondary cholangitis with stone formation.

In a recent case, following an operation for kidney stone, the patient developed jaundice with high temperature. On investigation, it was found that the patient had eighteen years previously been operated upon for stones in the common duct, at which time some eighteen stones had been removed. On re-operation, eighteen years later, a solitary stone was found in the ampulla which was covered with brown bile salts and no other stones were present behind this stone. On breaking off the outer covering, it was found that the mantle covered a typical faceted stone. Apparently this stone had been left behind at the early operation and had caused no symptoms for eighteen years. From this and other experiences, it is evident that though stones are present in the common duct, further stone formation behind these stones does not regularly take place though occasionally multiple smaller and larger stones may develop very quickly if the proper conditions are present in the duct system.

Doctor Dudley replied that there may have been a calculus present and he thought there was, because the patient was slightly jaundiced preceding the first operation, but there was not the massive collection of calculi present that there was at the second operation two months afterward. A great many were like casts of the smaller ducts and some were faceted.

SUTURE OF DISLOCATED ACROMIAL END OF CLAVICLE

Dr. Ralph Colp presented a man, forty-three years of age, who was admitted to the Surgical Service of Dr. Richard Lewisohn, Mt. Sinai Hospital, May 7, 1928, after having been struck by a moving taxicab and thrown so that he landed on his left shoulder.

Examination at the time disclosed a spasm of the left trapezius muscle, localized tenderness and crepitus at the acromial clavicular articulation, and

a definite dislocation of the acromial end of the clavicle. The humerus showed no evidence of fracture. X-ray examination confirmed physical findings of dislocation.

Four days after admission, under general anæsthesia, the acromial clavicular articulation was sutured by open operation. An infraclavicular incision from the middle line of the clavicle to the acromion of the scapula was made. The acromial ends of the clavicle and scapula were freed of muscle, and the conoid and trapezoid ligaments were found ruptured. The acromial process of the scapula, and the acromial end of the clavicle, were drilled with two holes each, and sutures of kangaroo tendon were passed approximating both these bony structures, although they were not tied. A kangaroo suture was then passed under the coracoid process of the scapula and over the clavicle, and this was tied when the acromioclavicular joint had been reëstablished by this suture. The sutures approximating the acromioclavicular joint were then tied. The trapezius and deltoid muscles were sutured over the joint, and the arm was placed in a Velpeau dressing reënforced by plaster. Eight days later the sutures were removed and a second Velpeau was applied.

Patient's shoulder was kept immobilized for six weeks, following which physiotherapy was instituted.

At the present time, the patient has a perfect anatomical and functional result.

Doctor Colp emphasized the point that the suture which is passed underneath the coracoid process really supplants the conoid and trapezoid ligaments until definite union takes place at the acromioclavicular joint. It has been found expedient in passing the suture under the coracoid to visualize the pectoralis minor by dissecting the pectoralis major from the clavicle. When this is done no difficulty is encountered in passing an aneurism needle under the coracoid process.

This method has been found quite effective in several other patients, and while the use of the fascia lata has been recommended in some cases, in our experience it has not been found essential.

STENOSIS OF THE COMMON BILE DUCT

Doctor Colp presented a woman, sixty years of age, who was admitted to Mt. Sinai Hospital, June 4, 1928. For twenty years she had vague symptoms of indigestion. During the eight months prior to her first admission, she had had five attacks of typical gall-stone colic. She was first admitted to the hospital March 3, 1926. She was then emaciated, acutely ill, with a globular mass situated in the right upper quadrant of the abdomen over which there was rigidity and tenderness. Jaundice was definite.

At operation the gall-bladder was found buried behind the stomach and duodenum through adhesions. When these were separated, a pericholecystitis abscess was found. The gall-bladder itself was shrunken, acutely inflamed, and contained a single calculus. A mass of adhesions ran over the lower part of the gall-bladder, and in order to find the cystic duct the gall-bladder was opened, and in carefully peeling back the adhesions, the common duct was inadvertently opened transversely to about one-fourth of its diameter. The choledochus was then dissected free, probed, and found patent throughout.

A cholecystectomy was perfomed. Troublesome hæmorrhage was encountered from what was supposed to have been the right hepatic vein. The gall-bladder bed was packed, a tube was inserted to Morrison's pouch, and one into the common duct.

Following the operation the patient reacted well, but after a few days she became intensely jaundiced and her temperature mounted, although there

was a free discharge of bile from the wound and bile was present in the stools. She evidently had an acute cholangitis.

The stools contained bile on repeated examination for thirteen days following the operation, after which they became clay colored and remained so until the date of discharge. The jaundice gradually disappeared, although her fistula persisted.

She was discharged on the thirty-eighth day, although it was felt the biliary fistula would be permanent, and would subsequently require transplantation into the stomach.

Two months later she was readmitted because of intense itching and she stated that two weeks after her discharge from the hospital her *sinus* had closed and she had become jaundiced again. When readmitted she was a markedly jaundiced woman. The abdominal examination was negative. The stools contained urobilin, the urine contained bile, and the van den Bergh reaction was positive, both direct, and indirect, 1 to 20,000. She was kept under observation for about one month and during this time her van den Bergh changed to 1 to 30,000, and bile again appeared in the stools. Upon her discharge, itching was still present and a diagnosis of inflammatory stricture of the common bile duct was made. She was then lost track of for two years when she again applied for readmission, that is on June 4, 1928, complaining of attacks of abdominal pain accompanied by nausea and vomiting; but what troubled her most was a generalized pruritus. At this time she was jaundiced. The abdominal examination was practically negative. The stools were clay colored, the urine contained bile, blood chemistry was practically normal, and the van den Bergh 1 to 70,000. At this admission, it was decided to perform an exploratory cœliotomy, and under spinal anæsthesia, supplanted by gas and oxygen, the previous incision was opened. After a very difficult and tedious dissection during which the duodenum was opened accidently, and immediately sutured, the common duct was found stenosed by scar tissue, which extended from just above the duodenum to a little beyond the entrance of the portal fissure. The scar tissue was excised, the proximal and distal portions of the common duct were identified, and one end of a rubber tube was placed up in the right hepatic duct, and the other end passed through the ampulla into the duodenum. This tube was completely covered by fatty, connective fibrous tissues of the gastrohepatic omentum by a double layer of interrupted sutures and a rubber dam drain placed down to the suture line.

Following the operation the patient did unusually well. However, there was a profuse discharge of bile from the wound for ten days during which time the stools were completely clay colored although the jaundice was markedly diminished. Twenty-one days after the operation, the biliary drainage suddenly stopped, the stools contained bile, the blood bilirubin figures were normal. A flat plate of the abdomen taken at this time showed the rubber tube in place.

Some time in February, after an interval of six months, X-ray examination failed to disclose the presence of the tube in the common bile duct.

The patient has been well since her operation except for the recent development of some upper abdominal pain. She has gained thirty pounds in weight. Her itching has practically disappeared and she is no longer jaundiced. The stools and urine are normal.

INTESTINAL OBSTRUCTION WITH PERFORATION

Dr. Ralph Colp presented a man, twenty-nine years of age, who was admitted to the Mt. Sinai Hospital, May 3, 1928. During July, 1924, he had

suffered from acute gangrenous appendicitis with pelvic abscess, for which an appendicectomy with pelvic drainage was performed. He ran rather an uneventful course until the eighteenth day when he developed signs of acute intestinal obstruction. Inasmuch as the original appendix incision was draining profusely, an incision was made in the left upper quadrant of the abdomen and a high jejunostomy performed. Following this, the intestinal obstruction was relieved, and the patient did well, although it took two weeks for the enterostomy to close following the removal of the tube.

After an interval of about a month, he was again admitted with signs of an incomplete intestinal obstruction, but following enemata and other medical measures the distention disappeared and he was discharged on the fourth day.

He remained well for three years, when he was again admitted with an acute history of three days' duration, manifested by abdominal cramps, persistent vomiting and obstipation. He appeared acutely ill, although his pulse and temperature were normal. The abdomen was distended and tympanitic throughout, not tender. Rectal examination disclosed a high, firm, acutely tender mass about the size of an apple occupying the cul-de-sac and apparently not in the rectal wall. A flat plate X-ray taken at the time disclosed small intestinal distention. The blood urea was 22, blood chloride 5.1 gram, and blood dioxide 71 milligrams. He was given a hypodermoclysis of 1000 cubic centimetres of saline solution, and under spinal anæsthesia, the old appendix incision was reopened and the abdomen explored. The jejunal loops were markedly dilated. In the pelvis there was a mass of matted intestines glued together by dense fibrous adhesions. Separating these adhesions, an abscess was encountered which contained about eight drams of thick yellow pus, which, on culture, grew bacillus coli and streptococcus hemolyticus. An intestinal loop in this area was crossed by a firm, dense adhesion, evidently the cause of the obstruction, and just proximal to this was a small perforation, evidently the origin of the abscess. The remainder of the intestine, although covered with fibrin, was viable. The distal loops were collapsed. There was no evidence of any peritonitis beyond this local area. The band was divided and the perforation in the bowel was closed by purse-string suture, which was reënforced with a Lembert of silk. Because of the fact that the patient had had an intestinal obstruction, and the lumen of the bowel was narrowed because of the constricting band and the closure of the perforation, a lateral suture entero-enterostomy was performed between the dilated and collapsed loops of the intestine. The pelvis was drained by a tube and the wound closed in layers.

Following the operation, the patient was acutely ill for a few days and was given continuous intravenous of glucose, 5 per cent. The wound became infected and there was a marked fascial slough. Following this, however, he made an uneventful recovery.

Since his discharge he has been well, has gained weight, and there have been no untoward symptoms excepting a hernia from his operative wound.

This case is shown because it illustrates the fact that while a high jejunostomy relieves the intestinal obstruction, the actual cause of the obstruction may still persist and manifest itself years later, in this case after an interval of three years. Secondly, it shows that in selected cases, the internal drainage of the obstructed loops by entero-enterostomy is not only quite effective, but it presents a procedure of dealing with intestinal stenosis which is certainly to be preferred to a resection in those cases in which it is practical.

MESIAL EMPYEMA OF THORAX

Dr. Alexis V. Moschcowitz presented a patient, fifty-two years of age, who was taken ill October 12, 1928, with pleurisy. He ran a very high temperature in the beginning of his illness, which gradually came down to normal and then again rose and ran an irregular course. The patient's principal complaint was that of pain in the chest, more marked, however, in front and on the right side. Aspiration November 24 revealed the presence of pus. X-ray examination of the chest revealed a rather atypical picture on the right side. There was a dense shadow which extended from the hilus of the lung to within one and one-half inches of the lateral chest wall, and from the third rib to the ninth rib posteriorly. In addition to the above, there was to be seen another ovoid shadow extending from the diaphragm as high as the seventh rib in the axillary line. The X-ray department diagnosticated a pleural effusion, though the possibility of a pulmonary neoplasm was also considered. In retrospect, it may be added that a positive diagnosis of a mesial empyema might have been made from the peculiar X-ray plate.

Operation November 27, 1928, under local anæsthesia. After preliminary aspiration, which again revealed the presence of thick, greenish pus, an intercostal incision was made, rather far back in the ninth interspace. Peculiarly, throughout the entire extent of the rather long incision, pulmonary tissue adherent to the chest wall was exposed. Finally, the posterior margin of the lung was noted right near the vertebral column and when this was gradually released and retracted outward, a cavity containing approximately 500 cubic centimetres of thick pus was entered and was drained by means of several drainage tubes.

The post-operative course was entirely uneventful. The cavity was dakinized in the usual manner, in spite of the presence of a demonstrable bronchial fistula. The patient was discharged on the fifty-second day after the operation with a small superficial granulating wound.

Mesial empyemata—that is, those bordered internally by the mediastinal pleura; anteriorly, by the hilus of the lung; and externally, by the visceral pleura—are to the speaker's mind of sufficient rarity to warrant presentation.

Dr. Howard Lilienthal said that a mesial empyema is very often overlooked. Median empyema is often characteristic of the secondary sacculation which may complicate ordinary empyema, and it should be noted that in the case just presented there was no deviation of the mediastinal structures; the heart was in normal position and the mediastinum perfectly straight. This is one of the diagnostic points. If one has operated upon an empyema of the usual kind and fever and signs of sepsis continue, and if the trouble, even with the aid of X-rays, cannot be found, one should immediately think of sacculations on the median side. Supraphrenic empyema is more apt to progress toward the median side than toward the lateral chest wall. In these cases it is very important that an early intercostal, generous exploration be made, lifting up the lower lobe from its adhesions to the diaphragm and exploring carefully toward the mid-line.

Just to illustrate how puzzling these cases may be, Doctor Lilienthal spoke of a patient, a young man, who had a general empyema and who developed a medial sacculation rather high up. An eminent medical consultant was called in by the family and, on examination, telephoned Doctor

Lilienthal he must operate immediately because the patient's heart was in the axilla and there was tense empyema of the right chest. Doctor Lilienthal heard the cardiac sounds in the left axilla but he questioned whether the heart was there. A röntgenogram revealed the heart in its normal position, as in the case of Doctor Moschcowitz. These mesial empyemata do exist; they are not particularly rare as secondary conditions and he thought this should be kept in mind by all surgeons doing work upon the chest.

TWO VARIETIES OF CARCINOMA IN ONE LOBE OF THE THYROID GLAND

Dr. Alexis V. Moschcowitz presented a man, forty-six years of age, who had always been in good health and who consulted him for a swelling occupying the left side of the neck. It had existed for about four months and it increased rather rapidly in size, and there was some difficulty in swallowing for the past month. On physical examination there was found a tumor, the size of an egg, which occupied the left lobe of the thyroid gland. The major portion of this tumor imparted to the examining finger a rather cystic feel. The lower and mesial part of the tumor at quite an appreciable distance from the previously described mass, and separated from it by apparently normal thyroid tissue, was much smaller than the former and so hard that the diagnosis of carcinoma of the thyroid was made without reservation.

The patient was operated upon November 27, 1928. Exposure in the usual manner and ligation of both the left superior and inferior thyroid arteries. As the lobe was being enucleated, the previously-mentioned large tumor was accidently broken into and a rather soft and grumous material escaped, which, on frozen section by Doctor Klemperer, proved to be a papillary cystadenocarcinoma of the thyroid. With this assured diagnosis, the entire lobe and isthmus were extirpated. The specimen, subsequent to removal, showed a second isolated tumor near the tracheal attachment of the thyroid gland, which on microscopic examination proved to be a scirrhous carcinoma.

The patient made an excellent recovery and was discharged healed fifteen days after operation. Since his discharge, he has received radiotherapy and thus far is in good health.

Doctor Moschcowitz presented this case on account of the rarity of the condition, namely, two separate and differing carcinomata in one lobe of the thyroid.

Dr. Charles Gordon Heyd said that about two years ago he presented before the society a case of carcinoma of the thyroid which had a scirrhous carcinoma on the right side and an adenocarcinoma on the left. The interesting feature of the case was the fact that the malignancy on either side could not have had a common origin. The carcinoma on the left side had grown downward and backward behind the carotid sheath so that the carotid artery on the left side was anterior to the tumor. Pearson, in England, had brought out that most of the carcinomata of this type had sprung from the ultimobronchial rest and were not, strictly, part of the thyroid until later growth incorporated them with the thyroid gland. The degree of malignancy varied very markedly. In the ordinary cystadenocarcinoma the expectation of longevity was fair, whereas the scirrhous infiltrated carcinoma was progressive and

later invaded the trachea and œsophagus. This was the ultimate outcome of the case presented before this society by Doctor Heyd.

Dr. Moschcowitz rejoined that in the particular case shown, there was no displacement, as the entire left lobe of the thyroid gland was situated in front of the carotid artery.

TYPHOID INFECTION OF THE COSTAL CARTILAGES

Dr. Alexis V. Moschcowitz presented a man, forty-three years of age, who had typhoid fever in December, 1924. In May, 1925, he noticed a rather painful swelling over the lower part of the right anterior chest wall. In the course of time, the skin perforated spontaneously and discharged pus. An X-ray examination at that time was negative. He reëntered the Norwegian Hospital and was operated upon for this condition three times; approximately in September and December of 1925, and in February, 1926, and also received diathermy. Subsequently, he entered Mt. Sinai Hospital and was operated upon twice; August 20 and December 24, 1926. The first operation consisted of a thorough removal of the cartilage of the involved seventh rib, from its junction with the osseous part of the rib into the sternum. A discharging sinus again formed, whereupon the patient was again operated December 24, 1926. This operation was similar to the preceding one, but in addition, the entire xiphoid appendix was extirpated and the end of the adjoining costal cartilage of the left side exposed and divided. He left the hospital one month later with a discharging sinus and with this condition he came into the reporter's care in November, 1927. The diagnosis was perfectly clear, namely, typhoid chondritis; and the indications, also perfectly clear, namely, the removal of the entire mass of cartilage of the sixth, seventh, eighth, ninth and tenth ribs on both sides.

Although he had intended to do both operations at one sitting, the first operation, November 12, 1927, owing to the numerous preceding operations, was so difficult and of such long duration, that when he had finished the right side, he deemed it best to postpone the operation upon the left side for a future time. Because of the infection, this wound was left wide open. Following the first operation, the patient developed a complete bilateral brachial plexus palsy. It was accounted for by the position of the arms upon the operating table, which was thought to be necessary because of the site and the extent of the operation.

The second and final operation took place December 7, 1927. This consisted of the extirpation of all of the cartilage of the sixth, seventh, eighth, ninth and tenth ribs on the left side. At the termination of the operation, no cut surface of cartilage was to be seen anywhere. This wound was sewn up completely with very slight drainage by means of a small tube and primary union resulted. The patient was discharged healed in fifty-nine days after his first operation and has remained healed ever since that time.

Dr. Nathan W. Green referred to a case in his service at the city hospital in which he thought the infection of the costal cartilages was due to tuberculosis, but was unable to differentiate between tuberculosis and typhoid. The man gave a history of typhoid some years previous. Doctor Green had effected a complete cure of the condition by merely taking out the cartilages on the left side, but it left the apex beat rather exposed. The patient did not seem to suffer any deleterious effect from this operation except that the expo-

sure of his heart worried him because it seemed unprotected. He wore a heavy leather pad over it afterward which seemed to reassure him.

Doctor Moschcowitz stated that it had been his experience in a number of cases that the costal cartilages redevelop rather well, though somewhat irregularly, after they have been extirpated subperichondrially. In the particular case shown tonight, the hiatus is already filled in by cartilage.

FRACTURE DISLOCATION OF THE CERVICAL SPINE

Dr. Alfred S. Taylor read a paper with the above title, for which see page 321.

STATED MEETING HELD APRIL 24, 1929

The President, Dr. Frank S. Mathews, in the Chair

SKELETAL TRACTION FOR SEPARATION OF LOWER EPIPHYSIS OF FEMUR

Dr. John J. Moorhead presented a boy, sixteen years of age, who was first seen by him at the Passaic General Hospital April 21, 1927, with Dr. G. J. VanSchott, Jr. Ten days prior he had been struck by the bumper of an automobile and had sustained an epiphyseal separation of the lower end of the femur, with such a marked displacement that the condyles and the patella lay anterior and on a level higher than the fracture. Several unavailing attempts had been made under an anæsthetic and by continued traction to reduce the deformity; a transfixion pin was finally introduced in the neighborhood of the head of the tibia just below the level of the tubercle, and a weight of twenty pounds was attached to the flexed limb. Within twenty-four hours X-ray examination showed beginning replacement. Eight days after the skeletal traction had been started the reduction was complete. The weights were gradually reduced and finally removed, with the transfixion pin, May 10. X-ray June 1 showed firm union. The transfixion wounds were then healed. He remained in the hospital until June 14 and at that time there was motion in the knee from full extension to about sixty degrees. He was seen by the reporter December 1, following. At that time he had a slight limp. There was no shortening but there was some adduction of the knee, and flexion of it amounted to about 100 degrees. Now, two years after injury, the extremity appears normal aside from the fact that he lacks fifteen degrees full flexion.

The efficacy of skeletal traction where other means fail is again justified in this instance. An interesting and important feature here is that there has been no interference with the growth of the limb, probably due to the fact that this patient was at the time of his injury sixteen years of age and that epiphysitis at that age-period apparently is not as serious a growth deterrent as it appears to be earlier in life. In another almost identical case in a younger boy, transfixion was used successfully after the lapse of several days. In this case, however, epiphyseal damage was evident and the growth of the limb was impaired. That, however, is in no manner ascribable to the transfixion.

ARTHROTOMY FOR HYPERTROPHIC OSTEO-ARTHRITIS

Dr. John J. Moorhead presented a man, forty-two years of age, with the following history: He was first seen January 17, 1927. His right knee-joint trouble began twenty-six years ago following a football accident. It was stated at that time that his cartilage had been displaced. He wore a brace on the knee for three years and the joint "went out" at intervals after slight exertion. This, however, ceased some six or eight years ago. The joint has

been continuously weak, swollen, painful and it always showed limitation of motion, particularly in extension. He sought relief for his continued dysfunction and pain and also because he was becoming bow-legged. For years he had been unable to lie on that knee. The joint was swollen particularly in the region of the head of the tibia. There was audible and palpable crepitus. There was apparently a definite bony overgrowth on the inner margin of the femur and a corresponding portion of the tibia. Motion was from 165 extension to 105 flexion.

May 23, 1927, at the Post-Graduate Hospital, a mediolateral arthrotomy was performed and at that time the diagnosis of osteo-arthritis was verified and it was also noted that the internal semilunar cartilage had been almost completely eroded in its central part and that what remained was curled and irregular. The subpatella fat pads were markedly increased and one pedunculated pad had a cartilaginous calculus. The osteophytes were removed together with the hypertrophied fat pads, synovia and damaged internal semilunar. In the after care, immediate active motion was employed. There was very little post-operative reaction.

September 26, 1927, he reported that the knee was free of pain and that he could make it do whatever he wanted. His improvement has continued up to the present, and he now has practically perfect function.

The reporter recalled to the society that in November, 1925, he read a paper with the title "Arthrotomy for Knee-joint Calculi" and at that time reported forty-nine cases. Accumulating experience has justified the prediction then made that the surgical knee by comparison with the medical knee was just as definite an entity as the surgical abdomen by comparison with the medical abdomen. At the present time the mediolateral approach is the operation of choice. The surgeon no longer makes the small incision except in young persons who give a very definite history of recent trouble, especially for athletes who have definite signs of semilunar injury. The ultra-aseptic Lane technic is used throughout. He was firmly convinced that there is a wide field for arthrotomy to relieve knee-joint dysfunction in non-traumatic cases and in those reawakened into activity by a more or less distinct trauma. He had now a series of 122 knee-joint arthrotomies, many of which were performed for osteo-arthritis of this same deforming and disabling type.

MOTOR-DRIVEN DEVICE FOR FRACTURES, DISLOCATIONS AND STIFF JOINTS

Dr. John J. Moorhead remarked that in the May, 1928, issue of the *American Journal of Surgery*, he published an article entitled "Setting Fractures by an Electromotive Device," in which were stated some recent experiences with a device called the "Articulator" which is a non-portable, motor-driven device with moving arms. A harness or strapping can be attached to any limb and in turn this is fastened to one of the arms of the machine and counter traction is applied to the other arm of the machine. When the apparatus is set in motion a definite pull and let go is provided. The amount of the pull in pounds and the length of the stroke, and to some extent the speed, can be controlled. It will thus be seen that the apparatus is in effect a motorized fracture table, differing in that the pull can be regulated and it is intermittent. Recognizing that this pull and let go principle was useful in the reduction of fractures and dislocations, he tried out the machine with enough success to believe that a somewhat simplified piece of apparatus would have a field in fracture service.

The device now presented does all that the *"Articulator"* did and in addition is portable, so that it can be brought to the patient anywhere that electricity is available. The present experimental apparatus weighs sixty-five pounds, is thirty-five inches long and seven inches high. A universal motor will be provided so that it can be used with direct or alternating current. In final form the weight will be reduced to about forty-five pounds. The advantages of a machine of this sort are apparent when it is realized that no fracture or dislocation is in reality set by setting the bone, but rather by setting the muscles and tendons which keep the bone in a distorted position. Any form of intermittent traction will act better on elastic muscles and tendons than continuous traction. For the relief of stiff joints, intermittent traction is of course a well-established principle. He had found in his short experience with the apparatus that he could obtain traction up to ninety pounds and that he could manipulate the fragments in a fracture after they had been distracted during the period when the machine is in a period of diastole. His practice is to gradually increase the pull until he has obtained very free crepitus and very free false motion and then stop the machine in a period of contraction and mould or manipulate the fragments, and if they apparently lock, then relax the tension and apply splintage. The ideal way of course is to do this under the fluoroscope, and in certain fractures it is possible to apply a circular plaster-of-Paris casing down as far as the fracture, then to leave a gap over the fracture and apply plaster on the rest of the limb. When the fracture has been aligned, the gap between at the fracture site is then filled with plaster and the casing is complete.

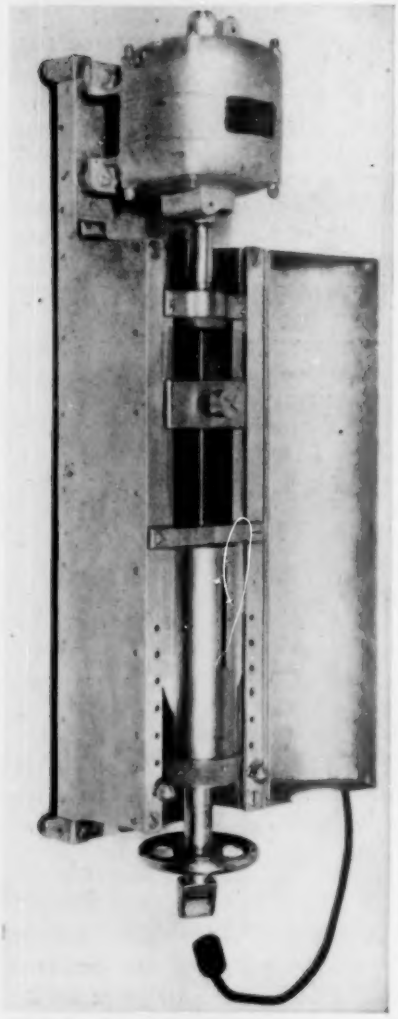

FIG. 1.—Device for manipulations required in the treatment of fractures, dislocations and stiff joints.

LONGITUDINAL FRACTURE OF THE PATELLA

DR. JOHN F. CONNORS presented a man, who, February 20, 1929, slipped and fell to the floor, striking his left knee. He was able to walk and had no pain or swelling. One hour later there was severe pain in the knee and he

was able to flex his leg only slightly. Slight swelling was present, no redness. An X-ray, taken in the usual positions, showed no signs of fracture. The following day the swelling had disappeared. On the third day the knee began to swell and upon measuring, the injured knee was one and one-half inches larger than the other. Another X-ray revealed nothing. There was no pain and at the end of this day the swelling again disappeared. On the fifth day the swelling reappeared accompanied by some pain, but with no loss of function, except that he was not able to go upstairs with his left leg as well as with his right. At this time a stereograph was taken which revealed a longitudinal fracture of the patella. (Figs. 2 and 3.) The knee was strapped diamond-shaped with plaster, the patella being left uncovered. He has completely recovered his function and has slight pain on stormy days, not at the joint but about two inches above in the quadriceps tendon.

FIG. 2.—Longitudinal fracture of the patella. Leg straight.

Scudder says that longitudinal fractures of the patella occur and should not be overlooked. A recurrent joint effusion, such as occurred in this case, would suggest the true condition. Stimson passes it over with this statement: "Vertical fractures are due to direct violence and rarely show much displacement." Roberts and Kelly, in 1921, reporting 1400 fractures, of which fifty-five were of the patella, saw no cases, but in a later issue they describe two cases.

FIG. 3.—Longitudinal fracture of the patella. Knee bent.

The speaker was of the opinion that in many instances these cases are overlooked for the reason that it is difficult to show by the X-ray, particularly when there is much effusion. The best picture of this case was made by flexing the knee and placing the plate at the lower border of the patella, the X-ray passing from above downward.

AVULSION FRACTURE OF THE CORACOID

DR. JOHN F. CONNORS presented a man, thirty-eight years of age, who was injured in an automobile accident. He was thrown from his seat striking his right shoulder. Immediately after the injury he had severe pain with complete loss of function. He was taken to a hospital in another state where he was X-rayed and a diagnosis of fracture of the right humerus was made. His arm was strapped to his right side with a pad in the axilla and it was kept in that position for four weeks. When the strapping was removed the function was in no way improved and any effort to use it caused a great deal of pain. Seven weeks following the injury he was able to resume his duties as a house cleaner, but the return of function was a very slow process.

March 13, 1929, he came to the clinic at Harlem Hospital, complaining of stiffness in the right shoulder with limited range of motion but not enough to prevent him from working as a house cleaner. Examination on this date showed that the prominence of the right shoulder was considerably decreased, no peri-articular tenderness, abduction of the right humerus to an angle of about seventy-five degrees, external rotation about fifteen degrees and internal rotation about forty degrees. An X-ray taken on this date revealed an avulsion fracture of the coracoid.

Since that time the patient has been receiving physiotherapy. At present the range of motion is practically normal and he is able to attend to his regular daily duties.

It is obvious that in this case the dislocated coracoid process was mistaken for a fracture through the greater tuberosity of the humerus. In searching the literature there is little said of this condition, although Speed says it is not uncommon and is caused by direct violence, such as by tackling in football and muscular action. Perhaps some of these cases of avulsion fracture of the coracoid have been treated for a fracture of the greater tuberosity of the humerus; but Cotton says, in the *"Archives of Röntgenology"* for October, 1919, "that fractures of the greater tuberosity of the humerus are rare." This case serves as a good illustration of conservatism and shows that anatomical position is not essential for obtaining function at or near joints.

Dr. Ralph Colp said that in July, 1928, a man was admitted to the Beekman Street Hospital, who had fallen from a scaffold and landed on his shoulder. He treated himself for two days, but finally came to the hospital with his arm held in absolute abduction and no motion in the shoulder-joint. X-ray showed a fracture at the base of the coracoid with a rotation of the process of about ninety degrees; the tip of the coracoid being pulled downward and inward. He was at first treated in abduction, but inasmuch as the pain persisted and the fragment remained rotated, it was deemed advisable to remove the coracoid. This presented no great technical difficulty. Following the operation the arm was kept in abduction for a period of two weeks when active motion was instituted. He was then lost sight of for a period of six months, when he was seen in the Follow-Up Clinic. His functional result was poor and there was marked limitation of all motion at the shoulder-joint, although there was no pain. X-ray taken at this time showed that the conoid and trapezoid ligaments were calcified and, in addition, there appeared some calcification of the other muscles. In the experience at the Beekman Street Hospital, fractures of the coracoid are extremely rare. In fact this is the first case ever noted there. Doctor Colp felt that if there were any cases in the future, the conservative method would be more conducive to better results than the removal of the body of the coracoid.

LIPOBLASTOMA OF THE NECK

Dr. E. W. Peterson presented a child, now about three and one-half years of age. He was born at the ninth month of gestation, the labor was normal, birth weight was six and three-quarter pounds. The infant cut his first teeth at five months, sat alone at seven months, talked and walked at twelve months of age. At about two years of age, following an attack of acute coryza, there developed a swelling just back of the angle of the jaw, on the left side, which apparently involved the left parotid gland. A diagnosis of mumps was made at this time. However, the swelling did not disappear, but increased in size, and after six weeks the child was sent in to the Babies' Ward of the Post-Graduate Hospital with a diagnosis of "cyst of the parotid gland." At no time was there any pain, redness or evidence of acute inflammation. The

general examination was negative except for the large swelling of the left side of the neck with a bulging forward of the left lateral pharyngeal wall. There was a single small gland on the right side of the neck, and small palpable glands in the axillary and inguinal regions. The tumor of the left side of the neck seemed to be made up of a conglomerate mass of soft glands. Hodgkin's disease and lymphosarcoma were considered in the efforts to make a diagnosis. The spleen could not be palpated, the liver was not enlarged and an X-ray examination showed the chest to be normal.

Biopsy and frozen section examination of the tissue was done February 23, 1928. An oblique incision was made over the tumor and an encapsulated growth was removed without any difficulty. It appeared to be a lobulated lipoma.

The pathological report by Doctor Alter is as follows:

Microscopic.—Section shows a very cellular growth.* The cells show malignant features as far as shape and size of cell are concerned. Most of the cells are polyhedral with a a granular protoplasm and small nucleus. A few of the cells have the typical signet-ring shape. There are frequent mitotic figures.

Diagnosis.—Lipoblastoma of the neck.

Dr. Edwin Beer said this case was practically an embryonal fat-cell tumor. Doctor Symmers has described some of these cases, and others are found in the French literature. One of these cases he had been observing for a long time, the first operation having been done in 1916 for a large, lobulated lipoma in the right popliteal space. This tumor was fairly well encapsulated, though these embryonal fat-cell tumors are not usually so. It was thought the tumor was removed completely. In 1922 a recurrence had developed in the right popliteal space and a large lipoma had developed at the base of the neck on the right side. Both these were removed. The next lipoma that was noted was a large tumor in the right inguinal region, partly superficial and partly intramuscular. In 1924 the popliteal tumor had recurred and was removed; at the same time, a tumor in the right inguinal region was also removed. At this time it looked as if there were a small recurrence of lipoma that had been removed at the right side of the neck. The popliteal tumor at this operation was found to be arborescent, running in between the various structures of the popliteal space and the adjacent muscles. At one place it seemed to infiltrate between the fibres of the muscles. The patient was given X-ray treatment, but despite exposure of the various areas to X-ray, in 1927 she returned with a small lipoma in the opposite popliteal space and a large lipoma in Scarpa's triangle on the left side. The recurrence in the neck was definitely larger and the right popliteal space was free. At this time she also complained of girdle sensation about the lower dorsal region, and later developed transverse myelitis. She was operated upon for this condition, and the embryonal fat-cell tumor was found pressing upon the cord extradurally and running into the intervertebral foramina on the left side (C. Elsberg). The lipoma in and about the spinal cord recurred. The patient finally died after a third spinal operation in 1928.

* This growth would recur if any of the capsule is left behind. They may be multiple in this neighborhood and may recur from other remnants. They do not usually metastasize.

MULTIPLE RESECTIONS FOR CHRONIC OSTEO-ARTHRITIS

DR. HENRY H. M. LYLE presented a woman who, at the age of thirty-one, entered his service at St. Luke's Hospital, in April, 1924. She was a poorly nourished female showing the typical lesions of a long-standing ankylosing polyarthritis. She was helpless and practically bedridden. She could not feed herself or take care of the ordinary toilet necessities of life. Thirty years ago, when this patient was six years old, she apparently had a severe attack of Still's disease. The first joints to be involved were the proximal interphalangeals, then the metacarpophalangeals, the wrists, elbows, shoulders, cervical spine, knees, hips, lumbar spine, etc. Although the involvement was symmetrical and assumed the usual centripetal advance the joints of the right side were attacked first.

FIG. 4.—Wrist and fingers ankylosed. The left thumb is fixed in the palm. The right is ankylosed and is forcing the anklylosed index toward the ulna side.

The conditions of these structures and the problems to be solved are best shown by the accompanying photographs and radiographs. (Figs. 4–11.) The joints are ankylosed in various unphysiological positions and with the exception of the hip and knee, ankle, and shoulder all the joints have been completely destroyed. The medullary canal of the humerus passes directly into the canal of the radius and ulna and these latter into the carpals, and the medullary canals of the metacarpal pass into the phalanges.

It was decided to attack the joints of the left arm in the following order: Wrist, fingers, elbow, shoulder and the right thumb. The patient's poor general condition made the ultimate result doubtful and we considered it better judgment not to depress her general morale by rendering both arms helpless at the same time.

FIG. 5.—Anteroposterior view of left wrist. Note ankylosed position of thumb and joints of wrist and hand.

April 26, 1926, *a combined partial resection and arthrodesis* of the left wrist was performed, the wrist being fixed in 30 per cent. dorsal flexion. In addition, an arthroplasty of the first metacarpophalangeal joint was performed overcoming the contracture and freeing the thumb from the palm. After stabilization of the wrist a ring extension splint was worn to overcome and stretch the flexor tendons. A fair grasp for light work was obtained

and the patient, for the first time, was able to write, sew, etc. This proved to be a great joy to her.

The patient returned the following spring and a *MacAusland arthroplasty* of the left elbow was performed. Fascia from the thigh was used as the interposing membrane. Some doubts regarding the use of fascia in this case was entertained on account of the very poor nutrition of the surrounding structures.

Five weeks after the operation some of the fascia sloughed and had to be removed. Judged by ordinary methods a good functional result was obtained, but as her cervical spine was fixed and she could not flex her head, some difficulty was experienced in reaching the mouth. The change in her general condition was most striking for with the increase of the functional use of the hand and arm came a marked increase in weight and muscular power. The biceps which had been a mere thread now could be felt. She stated she was ready for anything. March 19, 1928, a partial resection and arthrodesis of the right wrist was performed. March 28, 1928, an arthroplasty of the right elbow was performed through Langenbech's posterior incision. The ends of the bones were carefully moulded and eburnated by filing with fine wood-carvers' files. On account of his experience in the left elbow and in other cases of this nature the fascial covering was deliberately omitted. His faith in simple eburnation was justified. The patient was so pleased with the functional results that she demanded that she be given as good a left elbow as the right so January 15, 1929, the left elbow was revised. Through a Langenbech's incision the joint cavity was opened and it was found that the remaining fascia had formed dense connective tissue adhesions. These were excised and the articular ends of the bones carefully eburnated. All resections of the elbow were preceded by manipulation of the shoulder. After resection of the elbow the arm was placed in a Thomas splint with suspension and traction in the abducted position. As a result she has obtained the full range of flexion, one might almost call it hyperflexion. Note her strong extension. In order to get out of bed or a chair she has to put

FIG. 6.—Lateral view of left wrist. A similar condition is present in right wrist.

her full weight on her elbow-joints. This proves conclusively their stability. Further work is in progress on the small joints of the hand.

The patient, thanks to her intelligence and will power, has now become a wage-earning member of the community. She has contributed stories to one of our best magazines and now has had a scenario accepted.

IMPAIRED SHOULDER FUNCTION

Dr. Donald Gordon read a paper with the above title, for which see page 341.

Dr. Robert T. Morris asked Doctor Gordon how he classifies impaired function at the shoulder-joint, occurring after amputation of the breast. After these patients have suffered for a certain length of time adhesions have been found which require breaking up, but there is a limitation of movement which has no relation to the loss of muscle. One other point: where there are secondary changes with perhaps adhesions with a roughening of the cartilages or lessening of the synovial fluid, as is often seen in septic changes with gonococcus or streptococcus infection at the shoulder, a good plan is to inject a lubricant that remains for a long time. Doctor Morris uses one ounce of boroglyceride, three ounces of glycerine, and four ounces of Ringer solution, or isotonic saline solution, in an eight-ounce mixture. It is hygroscopic and draws toward itself interstitial infiltrates of tissue about the joint so that inflammatory pain may be relieved immediately or very promptly; sometimes within an hour in an old painful knee-joint. In the shoulder two or three or four drachms may be injected but only a few drops for a carpal articulation. The knee-joint will sometimes take more than an ounce of this artificial synovial fluid.

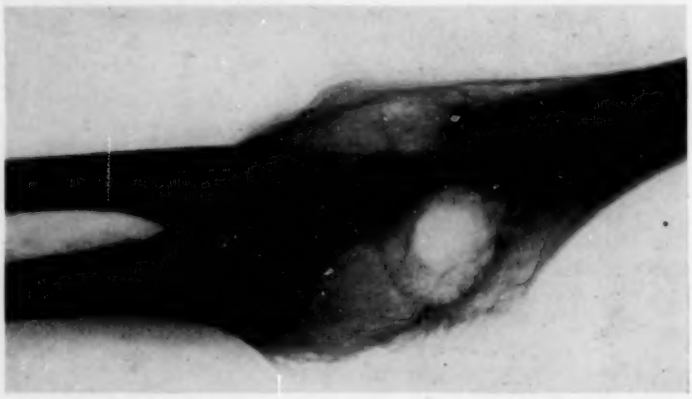

Fig. 7.—Left elbow showing bony ankylosis. Note that medullary cavity of humerus connects directly with those of the radius and ulna. A similar condition is present in right elbow.

Dr. Walter M. Brickner criticised Doctor Gordon's description of the stiff shoulder that is sometimes left after a Colles's fracture as a non-traumatic, extra-articular lesion that results from the patient's effort to immobilize his forearm by splinting the shoulder. This shoulder stiffness is not at all common in association with Colles's fracture and, in Doctor Brickner's experience, individuals with fractures at the wrist do not splint their shoulders. The occasional stiffness of the shoulder has been clearly described by Sir Robert Jones as an injury to the joint, a subacute traumatic arthritis or,

as Jones has also called it, "stubbing of the shoulder," occurring coincidentally with the Colles's fracture by transmission of the force to the shoulder-joint when the individual falls upon his outstretched arm.

Doctor Gordon has said that the shoulder disability that remains after the subsidence of the pain of an acute subacromial bursitis is due to muscle contracture. Doctor Brickner thought that this is not the entire explanation. In these cases adhesive bursitis and supraspinatus tendonitis (the underlying lesion) are still present after the subsidence of the acute symptoms. More often the converse picture obtains, namely, that pain, especially on certain motions, persists after full motion has been restored.

FIG. 8.—Condition of hand after multiple resection of metacarpophalangeal and interphalangeal joints.

FIG. 9.—Functional result after resection of both elbows.

It is commonly believed and taught that in unaffected shoulders the scapula does not begin to move in abduction until the arm is elevated to a right angle with the body. In Doctor Brickner's experience this varies with different individuals and it is not uncommon to find the scapula participating in abduction when the arm is raised about 70° or even less.

In describing the structures and the mechanics concerned in the shoulder, Doctor Gordon very clearly emphasized the importance of abduction in the treatment of, especially, peri-articular lesions and of joint fractures, both in the prevention and in the cure of shoulder disability. Sir Robert Jones, too, reminds us that the muscles attached to the upper end of the humerus spread out fan-like or cone-like to the shoulder girdle and chest; and when the arm

is abducted to or just beyond a right angle, the resultant pull of all these muscles is in the axis of the humerus, but if the arm is allowed to occupy a position nearer the body there is cross torsion by some of these muscles.

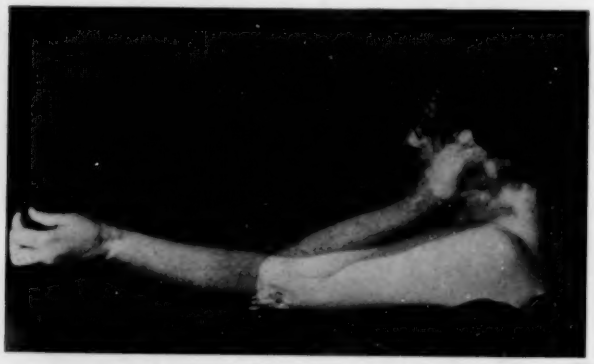

FIG. 10.—Superimposed photograph showing range of movement at elbow.

On the importance and value of abduction in the treatment of many shoulder conditions, there should be entire agreement with Doctor Gordon. Various methods are employed to secure this abduction, and very commonly used is fixation at right angles in an aeroplane splint or plaster case. In the treatment of both acute and chronic subdeltoid (subacromial) bursitis, of other varieties of peri-arthritis of the shoulder, of fracture of the greater tuberosity and even in many cases of fracture of the anatomical or surgical neck of the humerus,

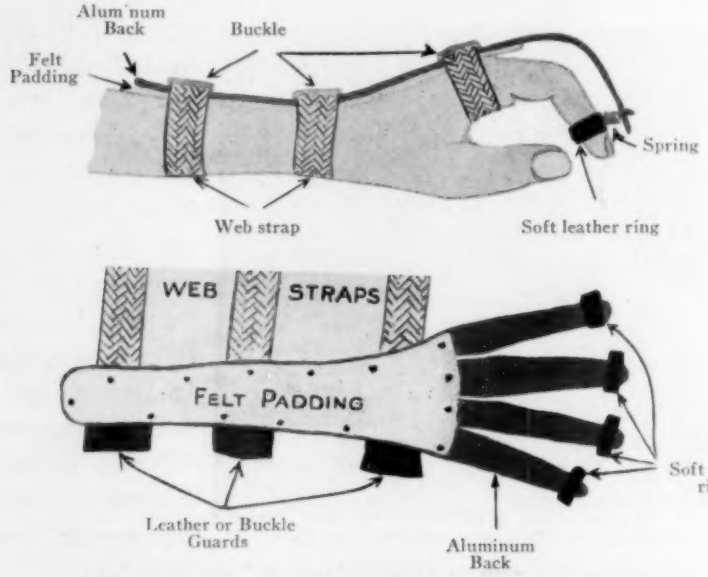

FIG. 11.—Drawing, made by the patient, of the splint worn by her to exemplify the functional use of her hand.

Doctor Brickner has found quite the most satisfactory abduction procedure, that method which he described some years ago—a non-immobilizing, automatic and easily regulable abduction in bed. With the patient recumbent upon an incline of pillows he abducts his arm as far as he can comfortably and without pain. In this position it is supported by small pillows and by

a simple sling of gauze or toweling fastened to the head of the bed. The recumbency itself relaxes much of the spasm and often passive or even active abduction is considerably greater lying down than when the arm is dependent. As the patient slips down in bed the arm goes up; and very often in cases of shoulder disability in which abduction has been limited to a comparatively small arc for many months the arm is found up alongside the head even in twenty-four or forty-eight hours. The sling can be slipped off and the arm brought down whenever the position becomes irksome or painful, and the treatment may be employed for short periods night and morning in individuals who are unwilling to remain in bed during the day. The method has the advantages of great simplicity and the avoidance of immobilization of the joint. When abduction has been thus restored it is maintained, and internal rotation is also restored, gradually, by means of a simple exercise with a light Indian club.

Doctor Brickner believes that subdeltoid bursitis is not infectious or toxic but it is traumatic in origin, due primarily to injury to the supraspinatus tendon. Not uncommon, however, is a monarticular arthritis of the shoulder, probably due to some low grade of infection, which is not infrequently mistreated for subdeltoid bursitis. It may be put down as axiomatic that if the joint cannot be moved in any direction, the lesion is intra- and not merely peri-articular.

Doctor Brickner agreed entirely with Doctor Gordon in the value of local heat, especially in helping to relax muscle spasm; and also in the observation that diathermy is very disappointing. In determining the value of any form of physical therapy it must be remembered that peri-arthritis of the shoulder of various types often subsides spontaneously.

Dr. John J. Moorhead said that next to back cases, shoulder cases give the most trouble from the standpoint of diagnosis, quite as much as they do from the standpoint of treatment. Doctor Gordon has illustrated a great many practical points of the treatment. He also rightly lays a great deal of stress on gentle massage and gentle active motion. Doctor Moorhead believed a great deal of harm is frequently done, although unwittingly, when an order is given for baking and massage; this should be supervised by the surgeon instead of sending the patient to the physiotherapy technician. A number are reactivated by rough massage and usage. In his own cases he has found that the combination of dry and moist heat, massage, and gradually regulated motions, without any other form of physiotherapy are usually sufficient. Diathermy was disappointing. Of all forms of physiotherapy, return to some form of work was the best physical and mental stimulant.

Doctor Gordon, in closing, said that his only answer to the kindly criticism was, that this has been based on his personal experience with shoulders, and the more he sees of them, the less he knows. The paper was written merely with the idea of passing on to some of the younger men some of his difficulties. He felt that when a patient came to his office with a shoulder, he wished he could get rid of him some other way.

In regard to Doctor Morris' question. He was trained to strap the arm of the mastectomy case close to the side of the body with the forearm across the chest. He does this still until there is no tendency to a painful reaction on abducting the arm. The time for this varies and is proportionate to the individual's reaction, tension of sutures, and degree of healing. The time necessary is from six to ten days. The arm is then loosened and an axillary pad and sling are used which gradually afford room for movements of necessity. Then the patients are instructed to proceed with the other exercises before atrophy of disuse develops. If movements are instituted too quickly on breast cases, he believes they develop a protective spasm, and in turn contracture.

He was speaking of extra-articular lesions and not intra-articular ones. He has not injected any joints.

In answer to Doctor Brickner's question. This was only his personal experience. He believes that in the mechanism of production of a Colles's fracture, there is an injury which can take place at the shoulder, but what he speaks of is not that type; but one where the painful fracture is improperly splinted. Doctor Gordon said he was acquainted with Doctor Brickner's method, but in the cases he has tried it on, he could not get the patient's arm up far enough on account of pain. It was purely a matter of a simple procedure for which he had not the proper technic, although it will probably work, and is a very essential technic with which to be familiar.

In regard to subacrominal bursitis being toxic. He has seen them clear up without manifest focal infection, and he has seen them develop and rapidly clear up with little treatment upon removal of focal infection.

BRIEF COMMUNICATIONS

WALLED IN APPENDICEAL ABSCESS IN AN INFANT EIGHT MONTHS OF AGE

ARTICLES on appendicitis in children emphasize the fact that the condition is more apt to go on to rupture and to general peritonitis than in adults. This is accounted for by the relative inability of the peritoneum to withstand infection and to the small size of the omentum, which does not afford a good barrier to the spread of infection. In small children there are frequently only a few adhesions and scarcely any attempt at localization.[1] The high incidence of peritonitis in appendicitis in children may to some extent be due to lack of recognition. So-called indigestion, colic, gastritis and so on may in reality be attacks of this disease which are not recognized until in an advanced state.[2] Children, again, are usually purged more than adults before coming to the physician, and the unnecessary and dangerous use of castor oil and other cathartics may have much to do with furthering what might, otherwise, be a simple pathological process.[3] With the above points in mind delay in operation is unwise and may give time for the development of peritonitis.[4]

The case reported here is unusual in that the infection took the final form of a well walled-off abscess, which was not opened until eighteen days after the onset of illness. The amount of pus evacuated, eight ounces, is also unusual and constituted, in proportion to the size of the child, an abscess of enormous size.

The patient, a male infant eight months of age, had been well up to the onset of the present illness. March 3, 1929, he was taken ill with vomiting and fever. He had fever more or less constantly as high as 102° to 104°. He lost weight, became progressively paler, did not take feedings well, and appeared to have distress in the abdomen. He was seen by the reporter March 21. He was pale and thin, apparently having lost much weight. Physical examination showed normal findings except for the abdomen. This was considerably distended with gas and on the right side a mass, bulging out into the flank, was detectable, extending from the costal margin to the pelvis. It was smooth, tense, dull to percussion, and showed no fluctuation, its rounded margin could be palpated halfway to the umbilicus. The abdomen was tender in this area. By rectal examination the mass was felt extending into the pelvis and here also it was firm and non-fluctuant. The temperature was 103.6°; the weight about eighteen pounds.

A urinalysis showed normal findings and the absence of pus cells and red blood cells was especially noted. The white blood count was 30,000; the hæmoglobin 55 per cent.; the red blood count 3,200,000.

Operation by Dr. C. F. Thomas. On opening the abdomen the mass came readily into view, felt firm, was not fluctuant and was attached by adhesions to neighboring coils of intestine. Upon opening into it a large amount of thin pus escaped. This it was impossible to measure but there were at least eight ounces of it. The appendix was not found nor was it searched for, as the child was not in good condition. The abdominal wall was closed with drainage. The organisms found were staphylococcus and hemolytic streptococcus.

After the operation the temperature remained elevated and the drainage from the

abscess was profuse. On the second day following, a blood transfusion was given into a neck vein. Soon after the temperature fell and varied from 99° to 101° for the next seven days. The baby took feedings well and, although the wound drained profusely, good progress was made. March 30 he experienced a severe gastro-intestinal upset with vomiting and diarrhœa which necessitated the use of parenteral fluid, and which gradually straightened out. He went home from the hospital April 4. The drainage continued in marked quantity, gradually ceasing, and the sinus became completely closed by May 27.

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AN INTESTINAL TROCAR--TRACTOR

I HAVE used with satisfaction for five years a new cork-screw type of intestinal trocar (photograph half size) which can be used as a tractor when the perforated coils are completely within the lumen of the gut, and for that reason prevents collapse, angulation and consequent contamination at point of puncture. After fixation of the distended intestine with Allis' clamps, a provisional purse string is applied at point of puncture. With continuous suction the trocar is screwed into the distended gut and ample time is taken for deflation. As a tractor the now hooded trocar can be pulled well outside the incision and any possible contamination can be safeguarded. Deflation and injection of saline solutions can be alternately applied by first shutting off manually the lumen of the intestine below and above the puncture. When the trocar is being withdrawn with continuous suction by being unscrewed, the purse string should be tied and subsequently reënforced with interrupted sutures, finally stitching lightly the omentum to this area. The menace of all methods of puncture of hyperdistended intestines is herniation of the rugous mucous membrane through the separation of fibres of the muscular layers of the intestine, especially at the periphery, and this menace can be mitigated by round puncture more especially when applied to the lateral walls of the intestine where the layers of muscles are less attenuated. This trocar is not suitable for permanent drainage.

FIG. 1

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BOOK REVIEWS

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by MRS. M. H. MELLISH, RICHARD M. HEWITT AND MILDRED A. FELKER. Vol. XX, 1928. Large octavo; cloth; pp. 1197. Philadelphia, W. S. Saunders Co., 1929.

This is the twentieth year that an annual volume has been issued containing the papers produced during a given year by the members of the Staff of the Mayo Clinic and Foundation A large number of these are reprinted in full from the various medical journals in which they were first published; some are abridged, and to some references only are given. In the present volume, 429 papers have come under consideration which represent the work of 214 authors. Of these, eighty-one papers are reprinted entire, forty-three are abridged and seventy-two are abstracted; of the remaining 233, references only are given. When one reflects that this is the output of one medical organization which is isolated so that it presents purely the opportunities and influence of a single scientific centre, one's appreciation of the magnitude and quality of the work is intensified.

When the two young Mayos in the late '80's after graduating in medicine, returned to their birthplace in an obscure town in Minnesota, they found as a field for them to work out their future the two agencies, St. Mary's Hospital, operated by a Roman Catholic sisterhood, and the State Hospital for the Insane, maintained in the immediate neighborhood of the town. In these two institutions they began the work which by the development and growth of thirty-six years has reached the magnitude which the present volume reflects. The first evidence of this work which the ANNALS OF SURGERY received was in the shape of two brief reports made by them, each of one case, which were published in the July issue of 1893, volume xviii, pages 26 and 28. The amazing growth both in amount, research, teaching, advancement, and in suggestions of greater work yet to be done which has been the outcome of the wisdom, the skill, the administrative ability and the grand character of these two men, is well illustrated by this volume which is before us and back of which are the nineteen other volumes which have preceded it.

In the present volume ten papers are from the pen of William J. Mayo and eleven papers from the pen of Charles Mayo. Of the other contributors, the names of Doctors Judd, Hunt, Rankin, Roundtree and Sheard appear the most frequently, each of these being credited with at least ten papers. The indices with which the volume is closed are worthy of mention. They contain an index of contributors, a bibliographic index, and an index of subjects, each of great value in facilitating the use of the book as a work of reference.

PRINCIPLES AND PRACTICE OF MINOR SURGERY, by EDWARD MILTON FOOTE, M.D., and EDWARD MEAKIN LIVINGSTON, M.D. Sixth edition; cloth; large octavo; pp. 755. New York, D. Appleton and Co., 1929.

The progress of modern surgery is well illustrated by the size and quality of this book. It is twenty-two years since the first edition appeared in 1907. During this period, the demand for it has occasioned repeated editions until now the sixth edition appears in this large and elaborate volume, in the preparation of which the original author has summoned to his aid a younger teacher. The important surgical positions which the two authors have held and in which they still continue to work make their teaching quite authoritative and warrant the statement that such teaching represents the present accepted methods in the schools of the city of New York.

While it is true that the field of minor surgery is the only one into which the average practitioner should ever enter, and is also the one in which most surgeons find the majority of their patients, it is also too often true, especially in these latter days, that the average practitioner is often willing to venture into the fields of the most formidable major surgery, especially when dealing with conditions that involve the abdomen and the pelvis. There is some excuse for this, however, in the fact that the average practitioner nowadays is one who has enjoyed not only a prolonged professional training, but has also had his one or two years hospital training as an interne, so that he presents a degree of surgical skill and experience which need no longer confine him to minor surgery. On the other hand, the increasing frequency of accidents resulting from the industrial and automotive conditions of the present day have widely increased the demands in the field of minor surgery. The demands of asepsis likewise have not only increased vastly the extent of the surgical field, but have introduced into surgery new responsibilities of great importance. The authors of the present work have not contented themselves with the suturing of wounds, the opening of abscesses, the application of bandages and the treatment of superficial and minor external affections, but extend its field to include the spinal tap, the treatment of syphilis, tuberculosis and other infective diseases, many tumors and congenital defects.

The illustrations are numerous and excellent in their character. The descriptions of various conditions and procedures are brief, clear and practical. As will be seen, the book is far from being a pocket manual, which is as it should be, for no pocket manual could do adequate justice to the conditions which this books attempts to describe.

LEWIS S. PILCHER

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